ANNUAL PIPELINE NUMBER

the OIL AND GAS JOURNAL

PUBLISHED WEEKLY SEPTEMBER 25, 1961

NEW CRUDE-OIL AND PRODUCTS PIPELINE WALL MAPS

UPDATING THOSE OLDER PIPELINE STATIONS

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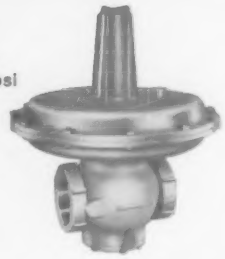
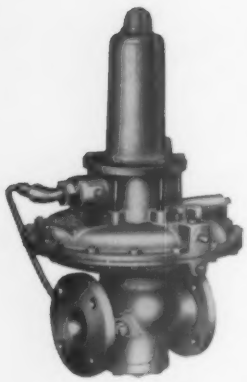
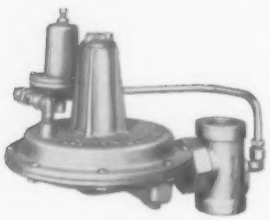


No. "120"
Low Pressure Regulator
Maximum Inlet Pressure—10 psi
Lbs. to inches
and lbs. to lbs. reduction
Bulletin 1044

NO. "080"
Instrument Regulator
Maximum Inlet Pressure—250 psi
Lbs. to lbs. reduction
Bulletin 1111



"No. 1001"
General Purpose Regulator
High Pressure Type—up to 250 psi inlet
Standard Type—up to 125 psi inlet
Lbs. to lbs. and lbs. to inches reduction
Bulletin 1059



No. "173"
Pilot Loaded Service Regulator
Maximum Inlet Pressure—100 psi
Lbs. to lbs. reduction
Bulletin 1113

No. "141"
High Pressure Field Regulator
Maximum Inlet Pressure—1500 psi
Lbs. to lbs. reduction
Bulletin 1024

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OIL AND GAS JOURNAL
Vol. 59, No. 39

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The Oil and Gas Journal is published weekly by The Petroleum Publishing Co., 211 S. Cheyenne, Tulsa 3, Okla. Second-Class postage paid at Tulsa, Okla. Copyright 1961 by The Petroleum Publishing Co. United States and foreign rates to the petroleum industry, 1 year $6, 2 years $9, 3 years $12.

ANNUAL PIPELINE NUMBER

SPECIAL SECTION: Updating Those Older Pipeline Stations **115-142**

1. Crude-Oil and Products Lines **115**

by John P. O'Donnell

Practically all crude-oil and products pipelines are involved in pump-station modernization, but it is a mixed picture. For some companies, modernization is a system-wide operation; others are approaching it on a piecemeal basis. Some companies are beginning to take steps others took long ago. Here are descriptions of procedures which seem assured of being widely adopted, as well as unconventional steps taken by some and scorned by others.

2. Natural-Gas Pipelines **129**

by H. C. Bozeman

Modernization of older compressor stations pays gas pipelines dividends in reduced operating costs and in better transmission efficiency. Gains are larger for the older stations. Insistence on reliability is a key point.

Columbium Steel May Mean Improved, Safer Line Pipe **143**

by A. G. Barkow

As a steel additive, this element adds appreciably to tensile and yield strengths. It also reduces hardenability, a valuable adjunct to welding. And it has very little effect on the ductility as measured by elongation and reduction of area.

New Practices Feature Alberta-California Line Construction **154**

by Paul Reed

Spreads in Alberta have broken records for laying 30 and 36-in. main-line pipe. And in British Columbia 80-ft. joints have been aggressively laid over alpine mountains. The whole project has demonstrated on large scale what can be accomplished by extensive use of double joints.

Aviation-Type Turbine Delivers for Columbia **168**

by Sy Orlofsky

The Columbia Gas System has operated a 10,500-hp. jet gas turbine, driving a two-stage centrifugal compressor at its Clementsville, Ky., station since October 31, 1960. Projected yearly operating costs are $21.70 per installed horsepower, comparable to four-cycle engine-driven centrifugal stations, and annual overhaul cost should not exceed $1.25 per installed horsepower.

TECHNOLOGY—OPERATION

Preventing Trouble in Dual Completions **185**

by Weldon Porter

Set the upper-zone packer with the short string, and keep the long string in tension.

Small Leases Can Profit from Crude Stabilization **186**

by William B. Davis and Leon B. Dorsey

The investment is small, and the payout is fast.

Processing Notes **196**

"Hot" piston ring checks ship's lube performances—Researchers fight bacterial contamination—Cyclohexane plant designed with computer control in mind.

Foreman's Page **198**

How to apply principles of distillation—Part 5.

DST Tools Help Rocky Mountain Drillers Free Stuck Pipe **201**

by Ed McGhee

Many Rocky Mountain stuck strings, once blamed on other causes, are actually wall stuck. Success has followed use of drill-stem-test tools, when spotting oil in the hole has failed to free the strings.

Pipeline-Construction Report **211**

THE OIL AND GAS JOURNAL **Newsletter**

September 25, 1961

Significant this week

As curtain starts lowering on Congress' first-half performance, oil industry is updating its checklist.

Biggest oil-related issue in second half of 87th Congress probably will be the oil-import-control program.

There'll be a lot of talk about taxes. Percentage depletion will get attention, too. But it isn't likely that major changes will be made in these areas next year.

Antitrust proposals may be oil's biggest worry (p. 91).

This issue, the Journal's Annual Pipeline Number, features a timely report on modernizing of older pipeline stations.

Other pipeline-section highlights include:

—An expert rundown on columbium steel, which may hold the key to better and safer line pipe.

—A comprehensive discussion of methods used in laying pipe for the Alberta-California line, 1961's top pipeline job.

—An information-packed article on the aviation-type gas-turbine concept in compressor-station design.

As a bonus, the issue is accompanied by exclusive maps showing crude and product pipelines in the U. S. and Canada.

Pipeline section begins on p. 115.

Second look at what Hurricane Carla did to Gulf Coast oil facilities shows damage was far worse than early reports.

Offshore damage may run as high as $100 million when full assessment is made. Onshore losses totaled millions more.

Both offshore and inland facilities were hit harder than they were in 1957, when Hurricane Audrey struck (p. 104).

If current trends go on, gas will surge past heating oil in Atlantic Coast markets.

That stretch is fuel oil's last stronghold. Gas already dominates residential heating and commercial fuel markets in other sections of the country.

In Atlantic Coast states, distillates now hold only 3-to-2 edge over gas (p. 98).

FPC Chairman Joseph C. Swidler's outspoken defense of area pricing gives this regulatory issue a shot in the arm.

Swidler's championship is sure to give fresh impetus to area-rate proceedings in Permian basin and in southern Louisi-

ana. Developments in these areas will help fix pattern for future proceedings elsewhere (p. 94).

Company balance sheets are beginning to show effects of manpower cuts in oil industry.

Employment costs are turning downward.

Automation's responsible for large portion of manpower reduction, but streamlining of operations apparently brought about most of the cuts (p. 100).

California's crude production is slipping—and there isn't much chance of a comeback.

State still ranks as third highest producer in U. S., but output isn't likely to start rising again (p. 102).

IRS says it will continue to handle ABC cases on merits.

Recently, agency suspended individual rulings while it considered taxing sellers in ABC transactions at 52% ordinary-income corporate rate instead of 25% capital-gain rate.

Industry protested this would hit producers hard.

Resumption of rulings indicates IRS won't push its original plan for change (p. 93).

Tanker survey by Sun Oil has turned up some interesting facts. Among them: United Kingdom replaced U. S. as second-ranking tanker nation in 1960, putting U. S. in tie with Norway for third place. Liberia held onto No. 1 spot, but trend away from Pan-Lib-Hon ships may be developing (p. 108).

New oil study points out that Middle East producing operations carry the load for companies which supply Eastern Hemisphere with "cut-rate" fuel.

Oil companies usually suffer a refining and marketing loss in this practice, according to Edward Symonds, petroleum economist for First National City Bank of New York. He warns that if loss starts to overpower producing profits, real trouble could result (p. 112).

Also of interest:

Justice Department has filed suit to block planned sale of Honolulu Oil to Tidewater and Pan American (p. 93).

Texas allowable for October is 8 days—again (p. 92).

Syria plans to be a major oil producer in 1964 (p. 111).

News in the making

Look for Gulf Oil this week to offer its post of chief counsel to U. S. District Judge Royce Savage, the Tulsa jurist who presided over the conspiracy trial in January 1960.

Gulf directors will vote Tuesday on a proposal to hire Savage.

Washington beat:

Showdown on oil-import-control program is just ahead.

Oil Import Administration is shaping proposals for Interior Assistant Secretary John M. Kelly, who hopes to put 1962 program on Secretary Stewart Udall's desk by October 1 and to make it public by October 15.

—Plan now calls for cut in crude imports and switch to crude demand as basis for determining quotas.

—Although changes in mechanics of residual-fuel-oil setup are being weighed, no major alteration in total is likely.

—It's virtually certain plan will include some deterrent to continuing increase of Canadian crude into U. S. Midwest.

—Entire program still faces big hurdles. It will be circulated inside the Government, including State, Defense, and—quite likely—the White House.

Watch for first computer-controlled operation of a pipeline—perhaps within a year or so.

Hardware for direct computer operation is now available, but programing and other problems still have to be solved.

"Keystop"method for taking product deliveries from pipelines or pipeline terminal tanks promises wider application.

Method eliminates attendant. Tank-truck operator's key identifies company receiving product.

Alberta Premier E. C. Manning expects Canadian crude and gas liquids exports to U. S. to hit maximum of 260,000 bbl. daily by 1965.

Breakdown: 110,000 bbl. daily to Midwest and 150,000 bbl. to Puget Sound area of Washington.

Exports the first half of this year averaged 83,500 bbl. daily to Midwest and 73,000 bbl. to Puget Sound, but this fall they have been stepped up to 110,000 and 95,000 respectively.

National Science Foundation hopes to choose a prime contractor for Mohole Project within a month or so.

Foundation officials say they're highly pleased with vlume of proposals they got from oil companies and others interested in ramrodding the experimental drilling.

Forecasters see a drilling pickup in western Canada.

Footage in first 8 months of 1961 was down 10%, but totals for last 4 months should reflect upturn. Active rigs are now running ahead of last year—160 compared with 150.

Producing Properties, Inc., Dallas, said last week it is considering several offers on sale of its assets or merger with other firms.

Company had planned to sell some of its unissued common stock for about $5 million and acquire more production, but this idea has been dropped. One reason: Uncertainty over future tax treatment of ABC-type production purchases.

Market memo

Sept. 25, 1961

Crude prices remain firm despite recent scattered adjustments.

What's more there seems to be no strong sentiment to whack the price of crude.

In fact, refiners attending NPRA at Atlantic City say they regard the crude market as strong, especially in Texas, and add that they can see no big cutting trend in sight soon.

Price changes thus far fit the pattern for adjustments only—and **more may yet come** in Texas because of disparities still existing in both East and West Texas.

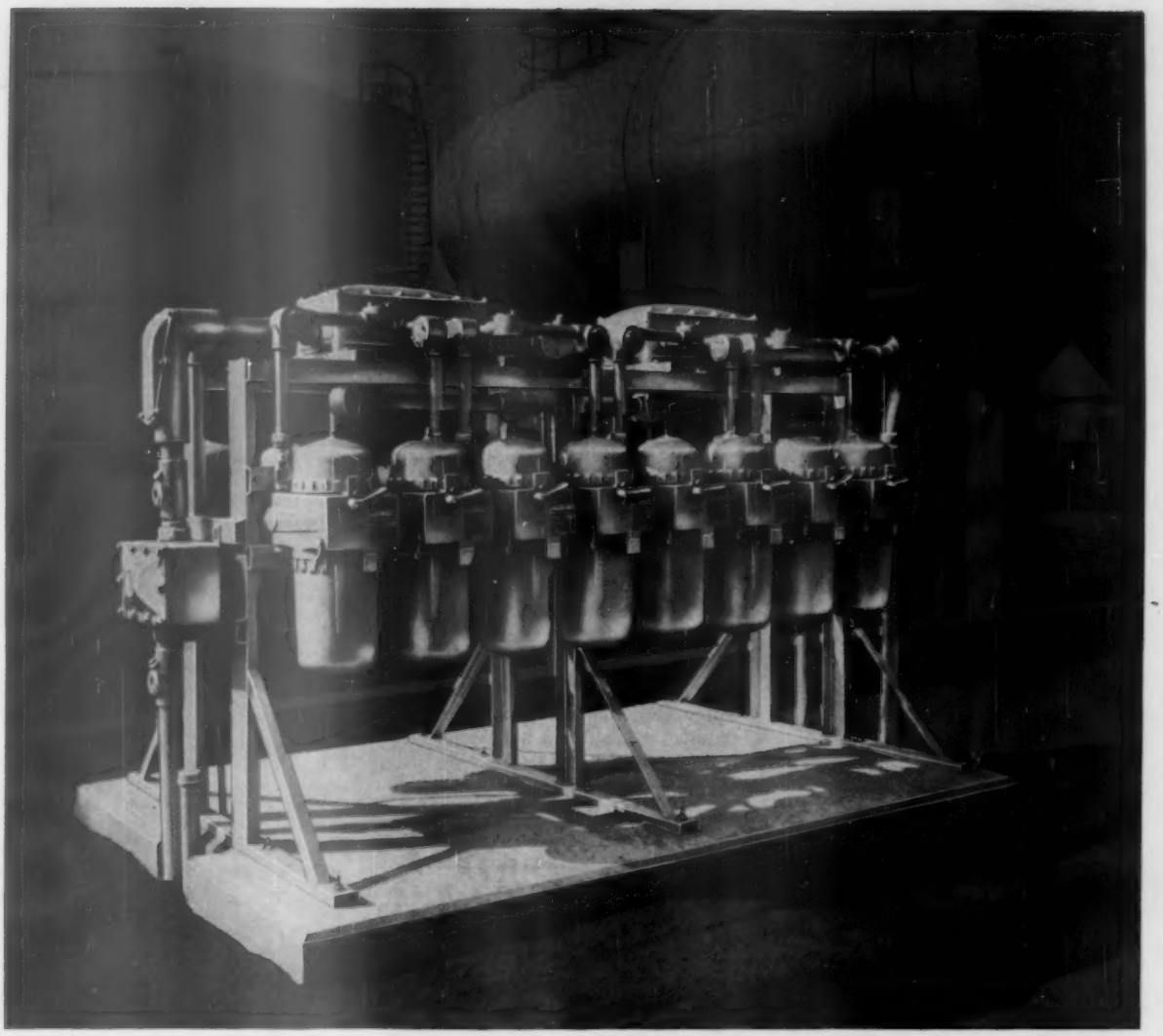
In East Texas, about 75% of the crude is moving at $3.10 per barrel. A few major purchasers, including Humble and Indiana Standard, still post at $3.25, and Atlantic Refining has priced at $3.05 for more than a year now.

In **West Texas and New Mexico,** sour crude also has three prices with a 14-cent spread. At the top is Gulf which since spring has posted at $3.01 with a 2-cent gravity differential. On the low side, which Continental joined recently, is a $2.95 price with a 3-cent differential. Indiana Standard last week moved in between with an average 8-cent increase by changing to a 2-cent differential, keeping the $2.95 top price.

Prospects are good at the moment that any immediate changes in West Texas-New Mexico sour will be upward. The **black crude is in good demand.** New refining processes can easily handle the sulfur, can reform the various low cuts into a higher percentage of gasoline and still have the asphalt and petrochemical feed stocks.

Shift in Sun's multiblend strategy bears watching. Sun may be dropping its policy of meeting private brands on the nose and may price a subregular gasoline at 1 cent above the independents and 1-cent below major-brand regular. **Tipoff came** when Sun moved into Chicago, Indianapolis, and Fort Wayne with only eight blends—not nine as heretofore. Sunoco 180, originally priced with private-brand regular at 2 cents under major regular, was dropped. Lowest blend now is Sunoco 190 at the 1-cent spread. Sunoco 180 also was dropped in Charlotte where the pricing experiment started. **Move adds emphasis to growing talk** that eventual outcome of present pricing battles may be a 1-cent spread between independents and the majors for regular gasoline.

Pricing trends: The **Gulf** reports firmer tone on gasoline due to shutdowns during Carla with only one-fourth cent discounts possible off posted 11 cents for 92-octane. No. 2 is firm at 8.5 cents . . . **River** markets remain quiet with movements slow . . . **Mid-Continent** still has an uneasy gasoline spot market at 10.25 cents for 91-regular. Some unbranded material reportedly is moving to jobbers at 10 cents. No. 2 is firm at 7.75 to 8 cents. Chicago prices have dropped one-half cent to 11 cents for spot 92-octane and discounting still persists . . . **East Coast weak spots** for gasoline remain at Buffalo, Norfolk, Charlotte, upstate New York, and New Hampshire . . . **In Los Angeles** price war has broken out primarily among independents with prices 6 cents off normal in some areas. Only few majors involved yet.



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Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

REDUCE GAS-SWEETENING COSTS

Two simple control tests increase plant efficiencies

Chemical analysis is the only quick and efficient method of gauging the operating efficiencies of plants that use monoethanolamine to sweeten natural gas. By proper interpretation of the simple, yet accurate tests, plants can be operated more efficiently and at some cost saving.

Quick titrations can give this information and enable the plant operator to keep safely below solution overloading, thus minimizing corrosion and solution contamination.

TEST NO. 1—ACID GAS CONCENTRATION

The total acid gas content of both the rich and the regenerated lean solutions is determined by simple titration. By comparing the acid gas contents of these solutions, before and after regeneration, the regeneration efficiency and the net solution loading can be determined. This net solution loading (the amount of acid gas removed by the solution) should check with an acid gas material balance around the absorber.

An excess of acid gas in both the rich and lean solution indicates solution overloading or improper regeneration.

When the rich solution loading is high, while the lean solution loading is quite modest (here indicating good regeneration), one of three things may be at fault: (1) Insufficient scrubber fluid circulation; (2) Insufficient amine concentration; (3) either more gas is being processed than anticipated, or the acid gas content is higher than originally expected.

An excess of acid gas in the lean solution, when the rich solution is not overloaded, indicates improper regeneration or severe solution contamination.

STEAM REQUIREMENTS FOR REGENERATION

Enough stripping vapor should be provided to the regeneration column to remove essentially all the acid gas from the rich solution before it enters the reboiler. Normal steam rates vary between 0.8 and 1.2 pounds of steam per gallon of amine solution circulated.

FLUID CIRCULATION

In plants with all carbon steel equipment the amine solution circulation rate should be adequate to keep the net solution loading at or below 0.4 moles of total acid gas (CO_2+H_2S) per mole of monoethanolamine. Under these conditions, in the conventional plant, the rich solution will contain less than 0.5 moles of total acid gas per mole of amine; and the lean solution will contain 0.1 or less moles of total acid gas per mole of amine.

Contamination can be controlled by a side stream distillation unit that removes foreign materials and amine degradation products.

TEST NO. 2—MONOETHANOLAMINE CONCENTRATION

By titrating a sample of the lean solution with standard HCl, to a pH of 4.5, the per cent of monoethanolamine free for acid gas absorbtion can be determined. This information allows for proper control of amine concentration and, therefore, proper setting of the circulation rate.

OTHER TESTS

Union Carbide has for many years maintained laboratories for the examination of scrubber solutions, and for basic research in gas treating technology. These are two of many analytical tests described in the paper "An Approach to Monoethanolamine Solution Control: Chemical Analysis and Its Interpretation." This paper relates chemical analysis to plant operation and suggests remedial steps found effective in eliminating operational difficulties. For a copy, use the coupon provided.

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- Increase pumping unit and rod life by reducing peak-torque reversal loads
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(9) POSITIVE SHUT OFF—The resilient seat exerts positive pressure against the metallic disc effecting positive seal from vacuum to full rated pressure.

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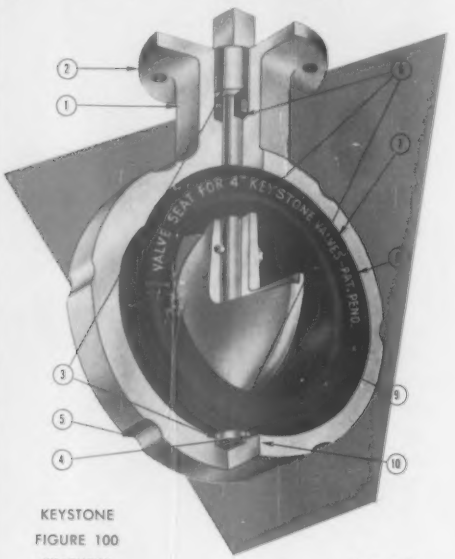

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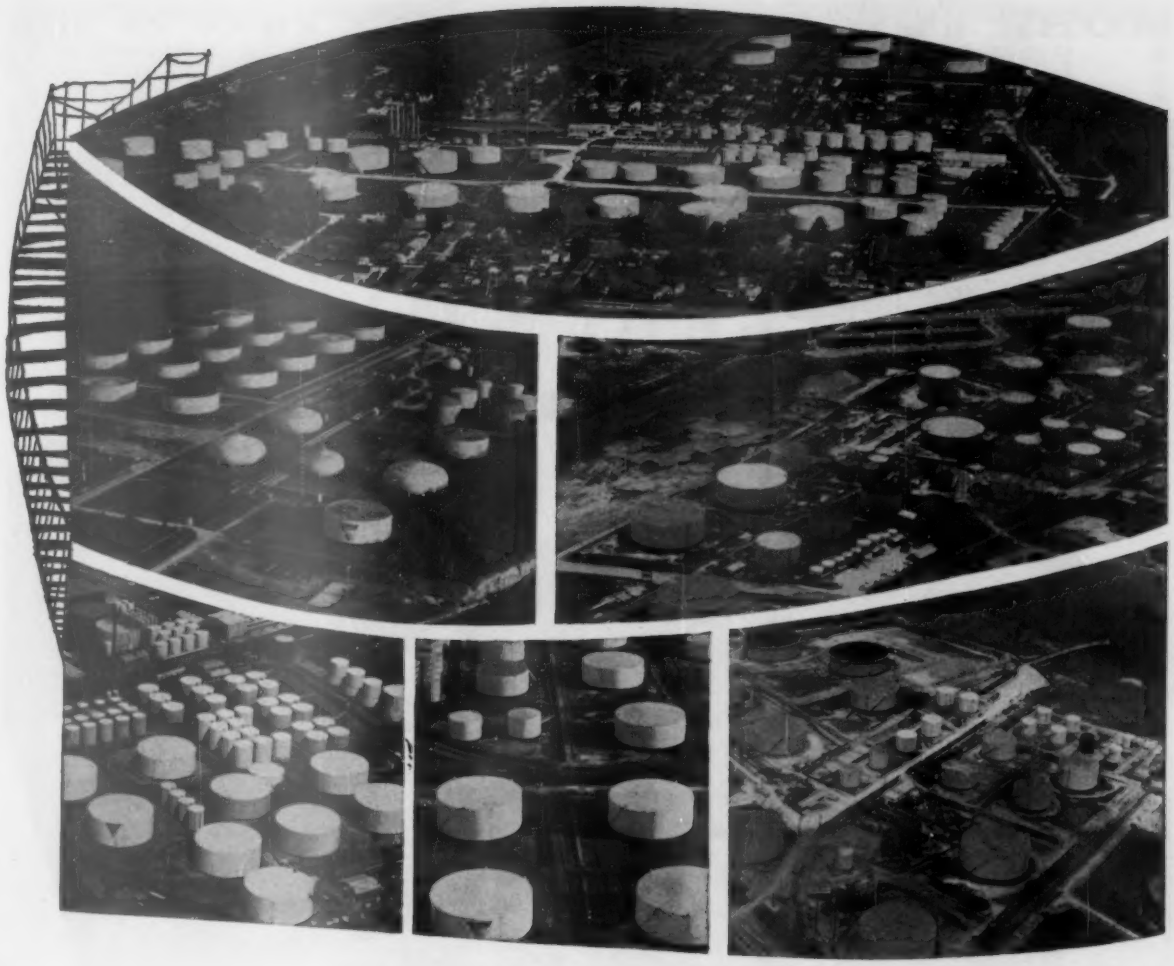

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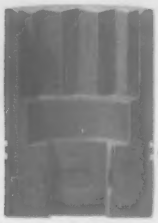
FEATURING COLD IMPACT EXTRUDED SOCKETS

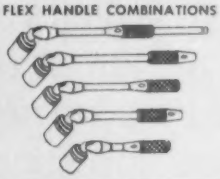
Cross section of conventional socket machined from bar stock and hot punched. Note undercut necessary for metal displacement by hot punching of double hex opening.



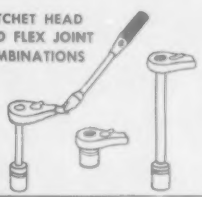
New impact extruded socket with closer tolerances has greater strength and longer life. Note the clean lines and lack of any undercut for metal displacement that comes with controlled metal displacement.

ONLY SEVEN DRIVER PARTS AND ELEVEN SOCKETS MAKE HUNDREDS OF QUICK-CHANGE DRIVER COMBINATIONS

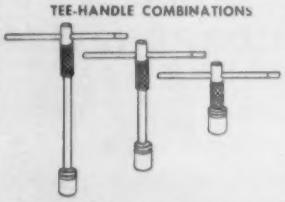
FLEX HANDLE COMBINATIONS



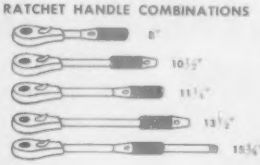
RATCHET HEAD AND FLEX JOINT COMBINATIONS



TEE-HANDLE COMBINATIONS



RATCHET HANDLE COMBINATIONS



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. . . all describe the greatest Socket Set Value ever offered. Lightweight and compact, it is as handy for field use as on the shop bench. All parts are made of selected alloy steel, heat-treated and finished with heavy chrome-plating over nickel. Drive parts ½ inch square . . . sockets from ⅜" to 1". Ask your Distributor for Williams Combo Set No. SP-1.

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DIVISION OF UNITED-GREENFIELD CORPORATION

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NEW economy | NEW safety | NEW efficiency

ON ROUTE DELIVERIES ALL-NEW 'Jeep' FLEETVAN

Payload	1,000 pounds
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Wheelbase	81 inches
Overall Length	154 inches
Load Space Volume	170 Cu. Ft.
Interior Height Rear Load Area	62½ inches
Length of Load Area	87½ inches
Interior Width Load Area	57 inches

Here's the newest, most economical walk-in delivery van you can buy—the sensational new 'Jeep' Fleetvan. Ideal for multi-stop delivery use! The Fleetvan parks easy. Maneuvers easy. New safety-designed front lets the driver see the road just a short way in front of the bumper. And the Fleetvan gives top gas economy too. These are just a few of the reasons the U. S. Post Office purchased over 6,000 'Jeep' Fleetvans. For full information on the 'Jeep' Fleetvan write to Mr. R. J. Kreusser, Fleet Sales Manager, Willys Motors, Inc., Toledo 1, Ohio.

'Jeep' FLEETVAN ®

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(FROM THE LEADER IN RADIO—RCA)

If you're cautious about specifying transistorized 2-way radio for your business . . . if you don't have full facts on the newest developments in radio communications equipment . . . you'll want to read this "Best Seller" by RCA. It's a fact-filled booklet that delves inside the "LD" (Low battery Drain) Mobile Radio; shows you why the "LD" gives you all the advantages of transistorization at a price comparable to all-tube equipment. Transistorized—yet easily serviced. Miserly in power consumption—yet generous in performance.

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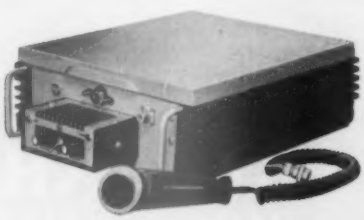
Read all about 2-way radio. You'll see why the new "LD" is today's best buy! Send coupon for your copy of this informative booklet.



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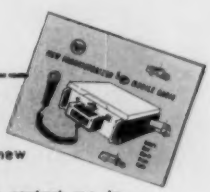

RADIO CORPORATION OF AMERICA
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DUCTILE IRON!

THE BIG PERFORMANCE LEADER IN DUCTILE IRON IS

STOCKHAM!

Unbeatable performance . . . substantial savings on initial cost . . . lower maintenance costs . . .

These are the three main reasons why engineers throughout the country are now specifying *Stockham* Ductile Iron Valves and Fittings as replacements for steel in many services.

For Stockham's leadership invariably produces the *best* of the *newest*.

Rigid metallurgical control involving continuous tests and analyses assures you superior ductility (far exceeding ASTM specifications) . . . excellent strength (comparable to carbon steel) . . . corrosion resistance (equal to cast iron and 5 to 7 times greater than steel) . . . wear resistance . . . and impact resistance.

These metallurgical superiorities . . . combined with the performance-proven advantages of Stockham's superior design features . . . make Stockham Ductile Iron Valves and Fittings the best and most economical choice for the following RECOMMENDED SERVICES:

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—Efficient replacement of cast steel valves in most petrochemical and hydro-carbon processing installations for services up to 650°F.

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STOCKHAM DUCTILE IRON VALVES—150 lb. class Globe, N R S Gate, O S & Y Gate, Venturi Pattern Gate.

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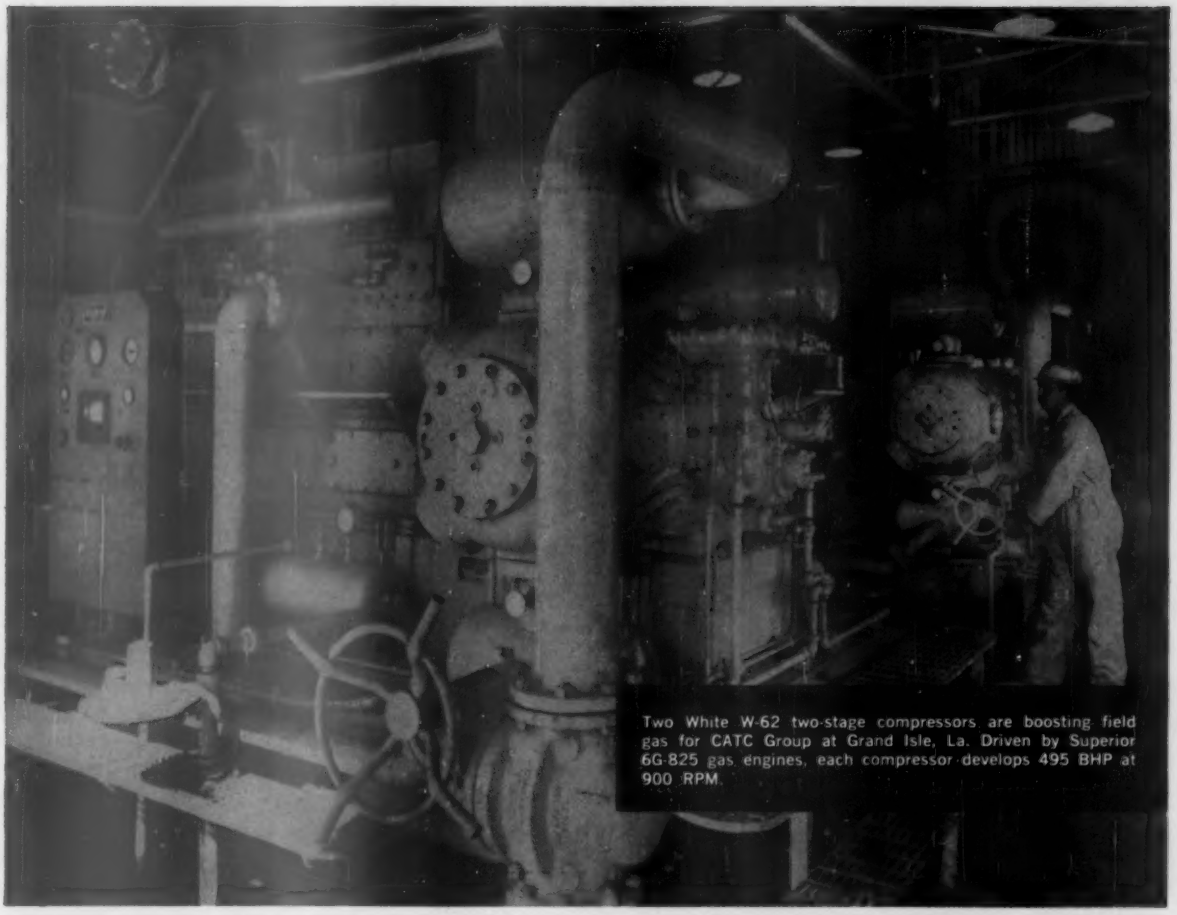


Two White W-62 two-stage compressors are boosting field gas for CATC Group at Grand Isle, La. Driven by Superior 6G-825 gas engines, each compressor develops 495 BHP at 900 RPM.

ONSHORE-OFFSHORE... CATC* Served

By White/Superior Engine-Compressor Sets

Two White/Superior engine-compressors on field gas booster service for CATC Group (Continental Oil Co., Operator) will be followed by two additional units, offshore. The recent order specifies two W-64 three-stage compressors driven by Superior 8G-825 gas engines, each developing 660 BHP at 900 RPM. Job site is CATC's Block 30 offshore platform, West Delta field, off Grand Isle, La. White's is the only *matched-design*, balanced-opposed unit available in the 660 HP category. It's specially suited to offshore service because there are no horizontal primary unbalanced forces to shake the platform and disturb auxiliary equipment and instrumentation.

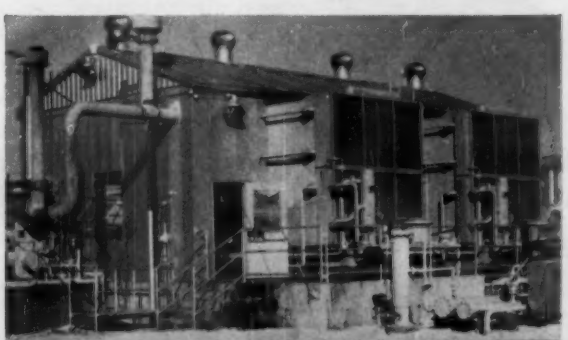
White's medium speed, heavy duty compressors—two, four and six-cylinder models, 200 to 1000 BHP—offer cylinder sizes from 4000 PSI, 2⅝" dia. to 85 PSI, 22½" dia., providing 68 standard cylinders. Custom sizes and designs are also available. Write for new Bulletin 124, describing compact packages for gas lifting, boosting, repressuring, peak shaving, underground storage applications, etc. White Diesel Engine Division, Springfield, Ohio.

**Continental Oil Company, Atlantic Refining Company, Tidewater Oil Company, Cities Service Oil Company*

White DIESEL | Superior ENGINES

White Diesel

ENGINES / COMPRESSORS



Engine exhaust gas is used for regeneration purposes on glycol dehydration unit.

Installation time for -25 seconds per joint

Water flood system installed at speeds up to 880 ft. per hour

Outstanding success with Du Pont **DELRIN** acetal resin pipe has been reported throughout the oil patch. Typical of this experience is a water flood system recently installed in Kentucky. Twenty-two 1½" flow lines were installed at speeds up to 880 feet per hour. Most joints were made within 25 seconds, using the simple, fast integral joining method based on heat fusion.

In addition, considerable time was saved at the well-head, separator and field header hookups, because with **DELRIN** pipe the need for precision cutting and threading is eliminated. Installation time for these hookups was reduced from hours to minutes. And the pipe was immediately pressure-tested. In fact, as soon as the last joint is completed, you can pressure-test a **DELRIN** pipe line at 150% of the rated long-term operating pressure.

DELRIN pipe was developed by Du Pont specifically for use in oil and gas production. It is manufactured, sold and serviced by the Du Pont Company. Here's why **DELRIN** pipe can offer the economy of long, trouble-free service:

- ***It is the strongest and toughest thermoplastic pipe on the market today.*** **DELRIN** pipe retains its high strength and toughness properties over operating temperatures ranging from sub-freezing to 180°F. It is even stronger under pressure-surging conditions than under steady peak pressures, and does not lose strength by oil absorption.
- ***It resists corrosion,*** both internally and externally, and it resists paraffin build-up under most field conditions.
- ***It offers increased flow*** because of extremely low friction loss. For example, operating experience has shown that the flow rate for 1½" **DELRIN** pipe is comparable to 2" steel pipe.

DELRIN pipe has been tested in over 6 years of laboratory work by Du Pont and by over three years of field installation in various oil-producing areas of the country.

MAIL COUPON FOR FULL DETAILS, including engineering specifications and a detailed analysis of various field installations. You will also receive full information on all the sizes and prices of **DELRIN** pipe and the location of your local Du Pont technical representative serving the oil industry.

DELRIN™ PIPE

ACETAL RESIN

Manufactured, sold and serviced by Du Pont

Du Pont Delrin™ pipe

1 Operator clamps the cold ring around the pipe at point indicated by depth gauge, while helper aligns pipe. This ring insures proper insertion of the pipe into the coupling during the heating operation.

2 Pipe is inserted into female die of heating tool, a lightweight unit powered by a portable generator or other electricity source. Coupled end of pipe is being heated by male die of the tool.

3 After 15 seconds, tool is removed and the pipe end is quickly pushed into the coupling until the cold ring touches the face of the coupling. Both operators align pipe to be sure joint is straight.

4 Within 10 seconds, the molten resin has solidified to give a leak-free integral joint. Pipe may be tested at pressures up to 150% of the rated pressure. Total joining time: 25 seconds.

DU PONT

BETTER THINGS FOR BETTER LIVING
... *THROUGH CHEMISTRY*

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Please send me complete information on **DELRIN PIPE** for oil-field installations.

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Position_____

Firm Name_____

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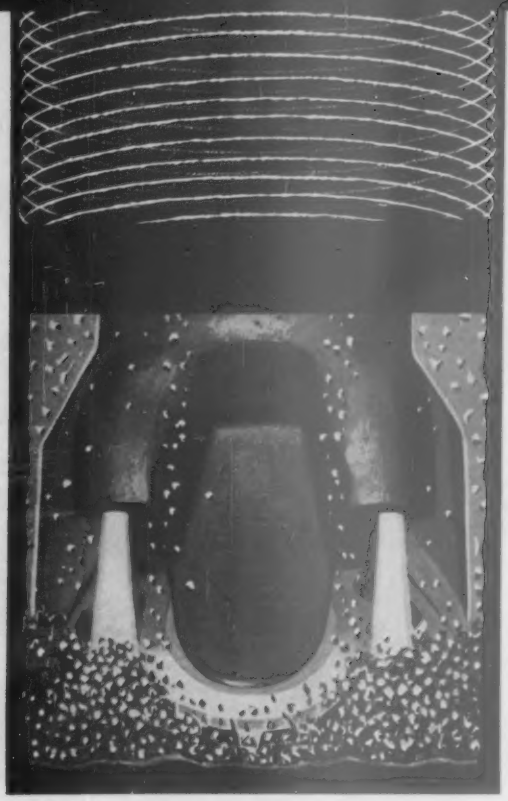
City_____ State_____



milling or drilling?

How can you tell if you're milling or drilling? It's easy. If you are using Reed Flush-Flo jet bits you **know** you're drilling ahead. Here's why—

1—The Flush-Flo ports allow an alternate route around the high velocity jets. Laboratory tests prove the Flush-Flo design allows the drilling fluid to sweep the entire bottom of the hole, whereas other jet type bits develop little fluid movement at the center.

2—Jet bits without Flush-Flo ports require all cuttings and circulating fluid to return past the high velocity discharge jets. Flush-Flo design provides up to 50% more return area, prevents re-circulating of cuttings, balling and re-drilling cuttings.

3—The Flush-Flo ports minimize hydrostatic pressure on the formation when running in the hole and minimize swabbing when pulling the string. These two factors afford maximum protection and minimum mud bills when drilling in lost circulation areas and leave wall cake and walls in better condition.

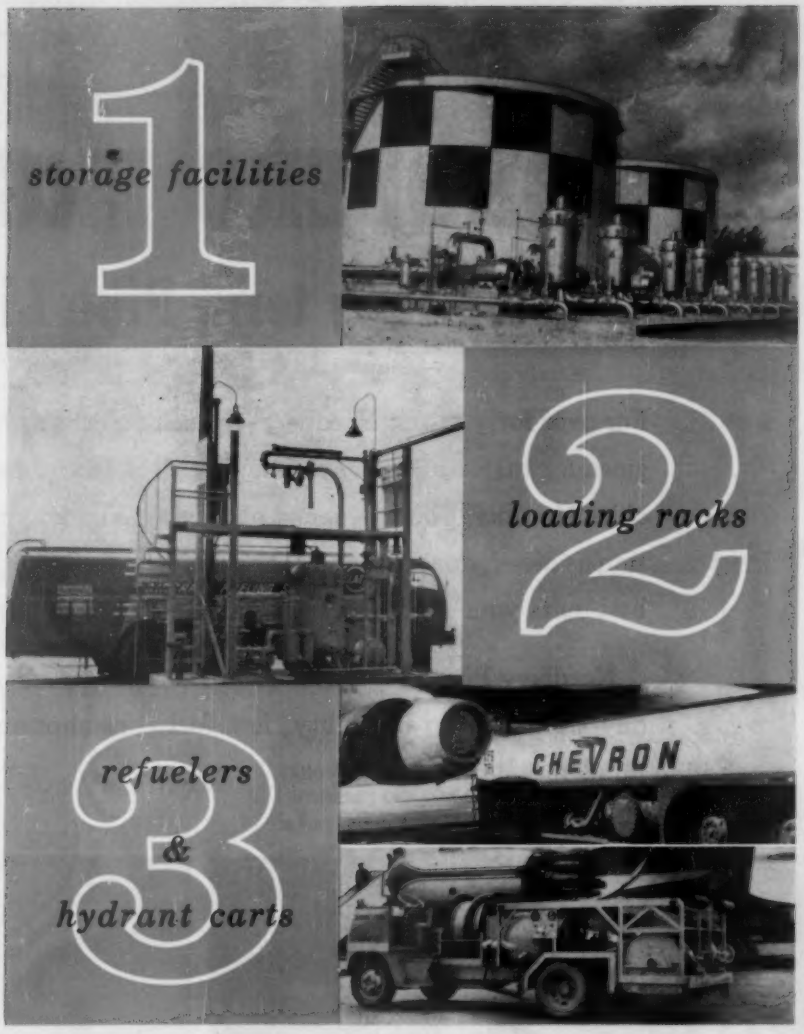
4—The flow pattern of the Flush-Flo jet bit provides less turbulence at the bit and affords greater protection in very soft formations.

The Flush-Flo design is an exclusive from the Reed research team—the most significant development since the advent of jet bits. The place to look for progress in drilling tools is right here at REED.

REED

DRILLING TOOLS × AIR TOOLS
ELECTRONICS

Reed Roller Bit Company, Houston 1, Texas • Export Office: Time and Life Bldg., Suite 3744 Rockefeller Center, New York 20, N.Y.



Warner Lewis Separator / Filters

Your Silent Servant of Safety

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Jet fuel picks up dirt, water, rust, scale and other contaminants in pipelines, storage tanks and feeder piping. To reduce jet engine maintenance and costly down time due to contaminated fuel, Warner Lewis 2-stage Separator/Filters REMOVE essentially all solid contaminant as well as 100% free or entrained water. Warner Lewis Separator/Filters are designed to customer specifications for the 3 basic fuel handling points serving airports: 1) storage facilities, 2) loading racks 3) refuelers and hydrant carts. Safety is of major importance to your company. Save hours of costly maintenance and protect your jets by fueling through Warner Lewis 2-stage water Separators/Filters.

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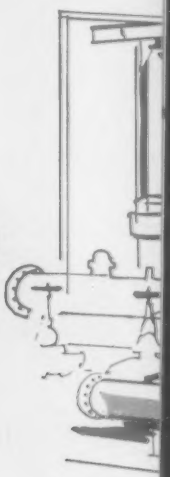
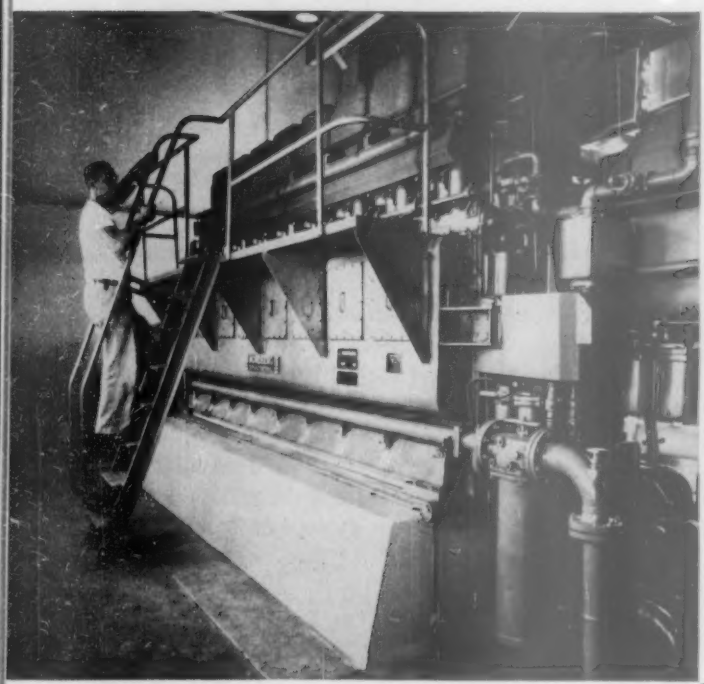


NORDBERG ENGINES

Pay Off in long term Pipe Line Service

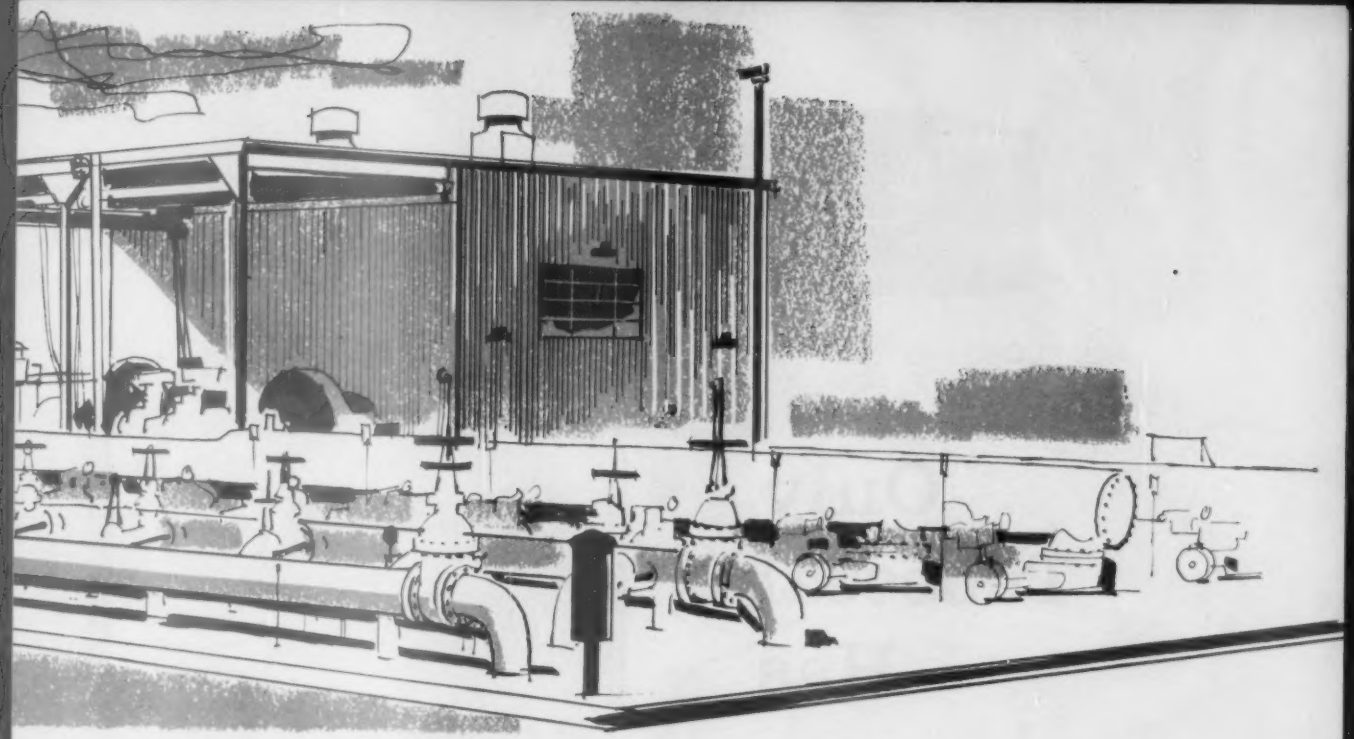
For over forty years, Nordberg—Busch-Sulzer has been building engines for major pipe line companies. This specialized experience enables Nordberg to recommend applicable engine types . . . for operation as diesel, dual-fuel and spark-ignition gas units . . . whatever fuel best suits your pumping operations on crude or products pipe lines.

Nordberg Pipe Line Engines have compiled a record of ruggedness, day-after-day dependability, low fuel consumption and low transmission costs year after year.



This remote-controlled 1750 hp Nordberg diesel serves the Texas Eastern Transmission Corporation booster station near Lafayette, Indiana.

One of two Nordberg 2000 hp dual-fuel engines lease-rented by Sinclair Pipe Line Company, to serve its Teague, Texas main line station.



Require simple, low cost buildings

Nordberg engine installations do not require expensive, complex station arrangements. Simple sheet metal construction is all that is required. Pumps, gears and auxiliaries can be installed outside, utilizing one supporting wall as a firewall.

Remote control "Push-Button" operation

Many Nordberg Pipe Line Engines are operating in automatic, unattended, remote controlled stations.

High thermal efficiency —low fuel cost

Nordberg Pipe Line Engines are noted for high thermal efficiencies and, consequently, low fuel costs. You are also your own "customer" when you use your own fuel.

Lease-rent for immediate payout

To offset higher initial costs of engine stations, Nordberg engines, pumps and all other mechanical equipment can be lease-rented. In fact, this method provides the lowest initial cost of any pipe line pumping arrangement.

WRITE for this brochure which explains further the advantages of lease-renting Nordberg engines. Ask for "Immediate Payout" booklet.

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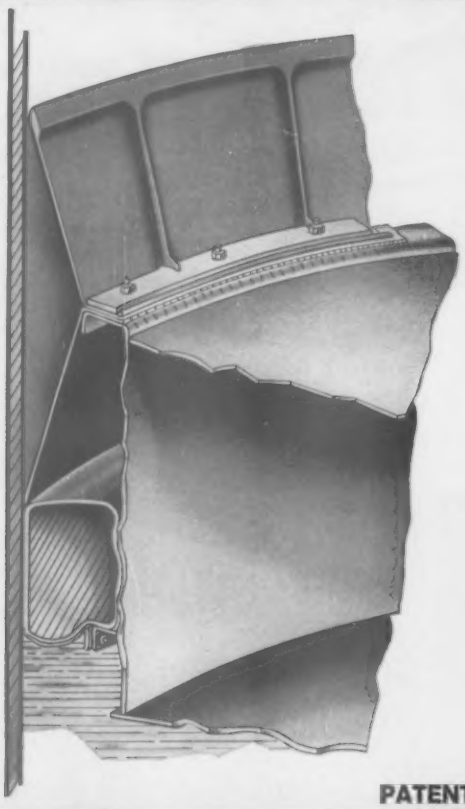
G161-R2

ALL FLOATING ROOF TANKS ARE FULLY EQUIPPED, **BUT...**

Only Tubeseal Has Lightning-Proof, Electro-Conductive Weather Shield



Tubeseal electro-conductive weather shields are an *exclusive tried and proved development*. They provide positive protection against lightning-caused rim fires. ■ How? By maintaining a *continuous* grounding bond between roof deck and shell—concentration of static charges is impossible. There has *never* been a lightning fire where any of the many hundreds of Tubeseal System Floating Roof Tanks are installed throughout the world—they're "lightning proof." ■ This is scientific and safe storage protection for the entire range of volatile products. Tubeseals can be installed on any of your tanks—new, old, riveted, or welded. You owe it to the future safety of your conservation facilities to investigate. Send for the Tubeseal Bulletin now—it could be important.

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722-MILE FINGER TIP COST CONTROL

for Pacific Gas Transmission Company and Alberta Natural Gas Company

A solid state pipeline control system from Dresser Electronics, SIE Division,

will allow maximum personnel efficiency and optimum operation for the 722-mile Pacific Northwest portion of the new Alberta-California pipeline system.

Rock-steady reliability is guaranteed by use of transistors and semi-conductor diodes—no moving parts, **no known failure mechanism.** Digital "computer-language" techniques eliminate transmission errors, provide computer compatibility. Functional groupings of **plug-in modules** insure easy and logical maintenance—all Dresser/SIE system **users continue employing their regular maintenance personnel and key operating people.**

Continuous scanning—made possible only with infinite-life solid state components—verifies proper system functioning **at all times.** Data, status panels, and alarms **always current.** Automatic compressor start-up . . . speed and units-on-line determined by remote-set station discharge-pressure controller . . . speed and inlet-vane position control on centrifugal compressors . . . pocket-clearance computer-controller for rated-torque operation of reciprocating compressors—all these combine for **minimum horsepower per MSCF pumped.**

Accelerate your cost reduction program.
Call the pioneers in solid-state pipeline control...

Dresser/SIE equipment is also in use or being built for: Colorado Interstate Gas Company, Continental Oil Company (Cherokee Pipe Line Co.), Mountain Fuel Supply Company, Magnolia Pipe Line Company, Continental Oil Company (Glacier Pipe Line Co.), Tennessee Gas Transmission Company and Nordberg Engines.

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The "OILWELL" string...

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SERVICES
STORES

Here's why "Oilwell" Century Pumping Units pay dividends

There's always a reason for success. In the case of our Century Pumping Units, the reason is as plain as day: we designed them *after* we surveyed operators to find out what they wanted in pumping units. They asked for dependability, economy, simplicity and safety. We gave it to them in these outstanding Century features:

Their *dependability* comes from the primary structural elements being rigidly welded and perfectly aligned with front samson post legs widely spaced on a solid, T-shaped base. Their *economy* comes from wearing parts engineered for *heavy-duty* service. Their *simplicity* and *convenience* in well servicing comes from an easy-to-roll-back arc with automatic latch, and from a one-piece slant-slot yoke. Ease of care and operation comes from the fact that routine maintenance can be done at ground level. *Safety* comes from the Type G Cranks that make maximum use of counterweights and are easy to adjust with the operator working safely to the side of the unit . . . with lots of toe room between weights and floor.

From design theory to the smallest actual details, Century Pumping Units are the most modern, most efficient available. For full information, write or ask for a free copy of our descriptive booklet 27-61.

USS and "Oilwell" are registered trademarks

The service is great in The Pump Room

It's a different sort of menu than you'll find in Chicago's famous Pump Room, but you can't beat "Oilwell" pump shop service anywhere. Every "Oilwell" pump shop is staffed with specialists who have a background of technical and operating experience. They're there to help you with your pump problems, whether it's pump selection, maintenance, or reworking. On certain pumps, such as SPUN METAL sectional liner subsurface barrels, "Oilwell" offers an *exchange service* that gives you an indentical reworked barrel at less than half its original cost. No matter what your pump problem is, take it to the nearest "Oilwell" pump shop where you'll get the superior service that comes with every "Oilwell" product you buy.

Meet Don O'Bryan

Don is the "Oilwell" store manager in Houston, and he has the background it takes to help you with your problems. He's been with "Oilwell" 28 years, and he knows the oil business inside and out.

Every "Oilwell" store manager is there to see that you get what you need—emergency-fast when necessary. From pumping unit and prime mover to the perforated nipple on the bottom of your tubing string, "Oilwell" stores are stocked with top quality producing equipment in the types and sizes that are locally popular. They carry everything you need from the hundred-and-one fittings, small tools and miscellaneous hardware to flashlight batteries and wiping rags. And store men like Don O'Bryan have access to the knowledge and up-to-the minute information to help you on practically any equipment problem. That's a good reason for stopping by your "Oilwell" store.

USS **Oil Well Supply Division of United States Steel**

Executive and Export Offices: Dallas, Texas

LARKIN SCRATCHERS

Combine all the features proved best for effective scratcher performance.

LARKIN CENTRALIZERS

Long Lok-on
Fig. 905

Short Lok-on
Fig. 904

LARKIN

...Through Your Supply Store

Short Slip-on
Fig. 902

Long Slip-on
Fig. 903

Larkin Centralizers exceed all known requirements for centralizer performance. Their time-proved design combines the highest centering force with the lowest permanent set obtainable in a non-rigid centralizer.

Larkin Centralizers are furnished in four different types and each type is available in five different ranges. There is a Larkin Centralizer for every well condition and casing/hole size combination.

Larkin Centralizers need not be under compression to exert the required centering force. High centering strength at initial deflection allows use of Larkin Centralizers with the bows slightly under hole size. This results in easier starting and easier running with greatly lessened scraping of the well bore.

Larkin Scratchers and Centralizers are available . . . "Through Your Supply Store."

LARKIN PACKER COMPANY

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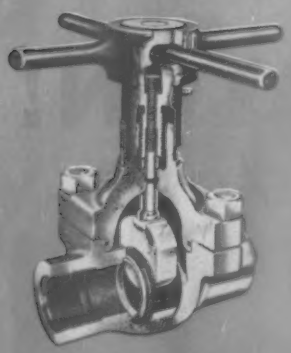

Figure 2126 Resilient Seat Gate Valve. 2", 3", 4", 2000 lb W.P. EValcoat protective Plastic Coating.

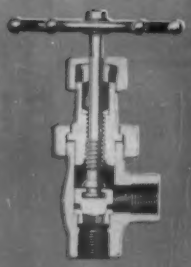

Figure 2699 Forged Steel Angle Valve. ½", ¾", 1", 2000 lbWOG. Not Plastic Coated.

Figure 152J Forged Steel Gage Valve. Size ½", 4000 lb WOG. Not Plastic Coated.

Figure 2698 Throttle Disk Forged Steel Globe Valve. Size 1", 2000 lb WOG. EValcoat Plastic Coating.

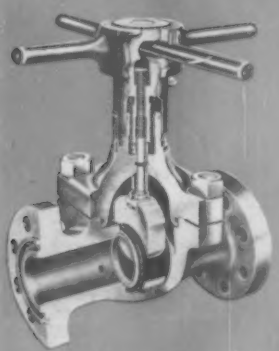

Figure 3116 Resilient Seat Gate Valve. 2", 3", 4", 2160 lb W.P. EValcoat protective Plastic Coating.

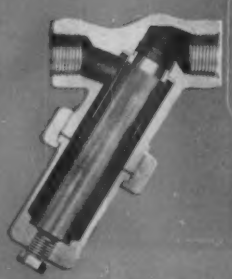

Figure 126 Forged Steel Strainer. Size 1", 2000 lb WOG. EValcoat protective Plastic Coating.

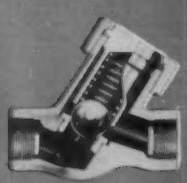

Figure 2676 Forged Steel Check Valve. Size 1", 2000 lb WOG. EValcoat protective Plastic Coating.

Figure 448 Forged Steel Globe Valve. 1½", 2", 2000 lb WOG. Not Plastic Coated.

NEW, BROADENED LINE OF ROCKWELL-BUILT EDWARD STEEL WATERFLOOD VALVES

Available with and without exclusive EValcoat* protective plastic coating

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another fine product by
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*EValcoat is a Trade Mark of Edward Valves, Inc. 6016

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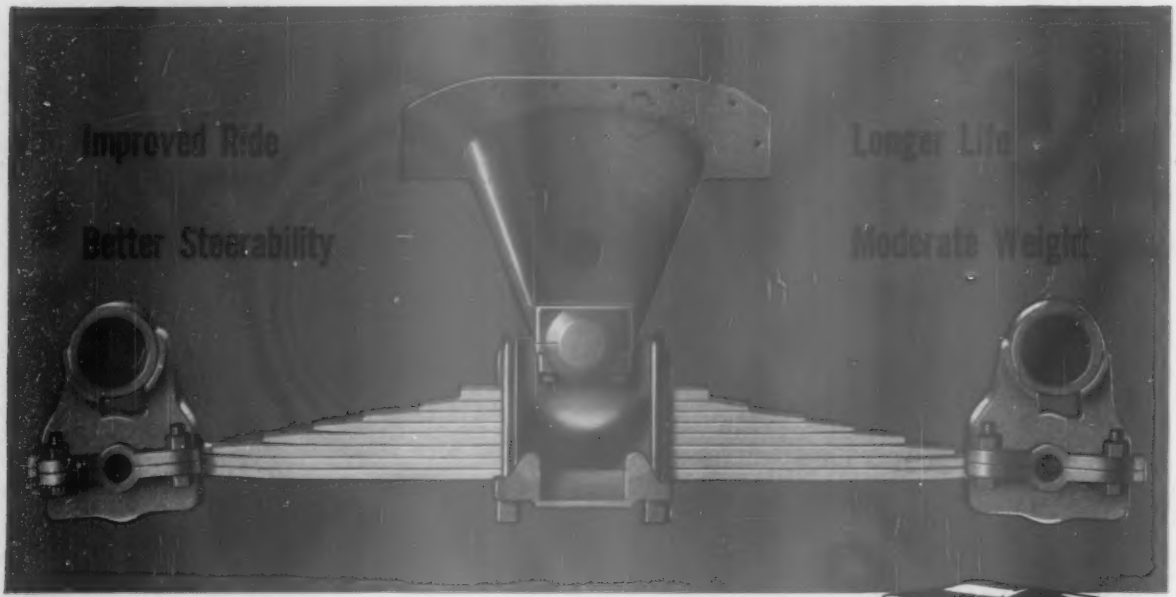

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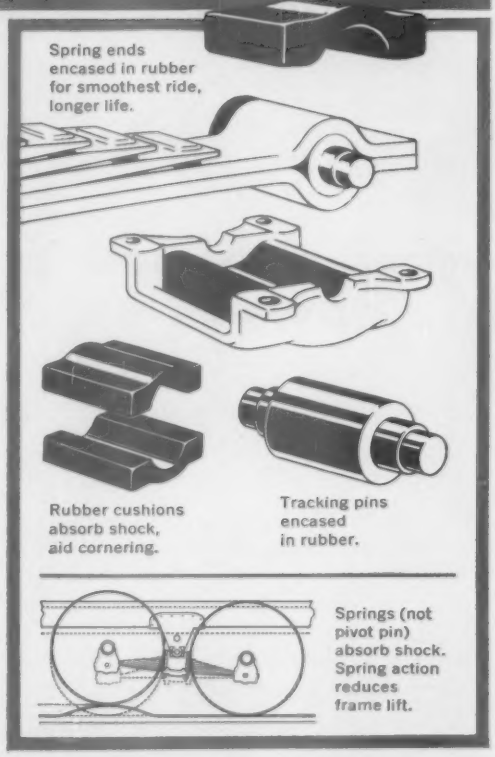
RUBBER!

This new Eaton suspension takes full advantage of tough, resilient rubber at all points of movement. The result: a smoother ride (loaded or empty), long trouble-free service, more payload and easy, quick servicing when required.

Springs are long, widely spaced with variable rate. Spring ends have rubber cushions and bushings. Rubber inserts between spring leaves reduce interleaf friction. Rugged tracking pins are suspended in rubber. All these mean more driver comfort, more cargo safety, longer equipment life on or off the highway.

Drive and alignment are through **two** main leaves and tracking pin. No lubrication is required.

Ask your truck dealer for complete details on the new Eaton Tandem Suspension, or write us direct.


Spring ends encased in rubber for smoothest ride, longer life.
Rubber cushions absorb shock, aid cornering.
Tracking pins encased in rubber.
Springs (not pivot pin) absorb shock. Spring action reduces frame lift.

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• **TANKHIDE also helps keep tank maintenance costs low,** and gives greater protection against weather-wear and corrosion, because of its remarkable toughness and durability.

• **Information on these advantages is easy to get.** Just write, wire or phone Pittsburgh Plate Glass Company, Industrial Finishes, 1 Gateway Center, Pittsburgh 22, Pa.

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New Peerless Gas Cleaner development provides cleaner gas at less cost

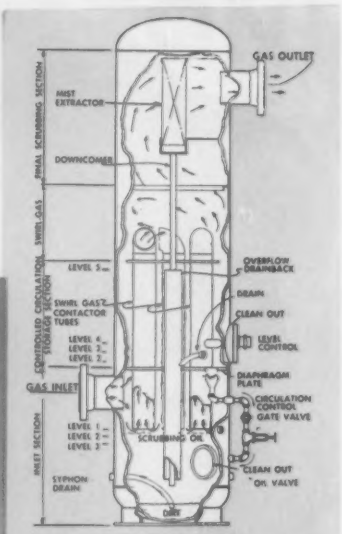
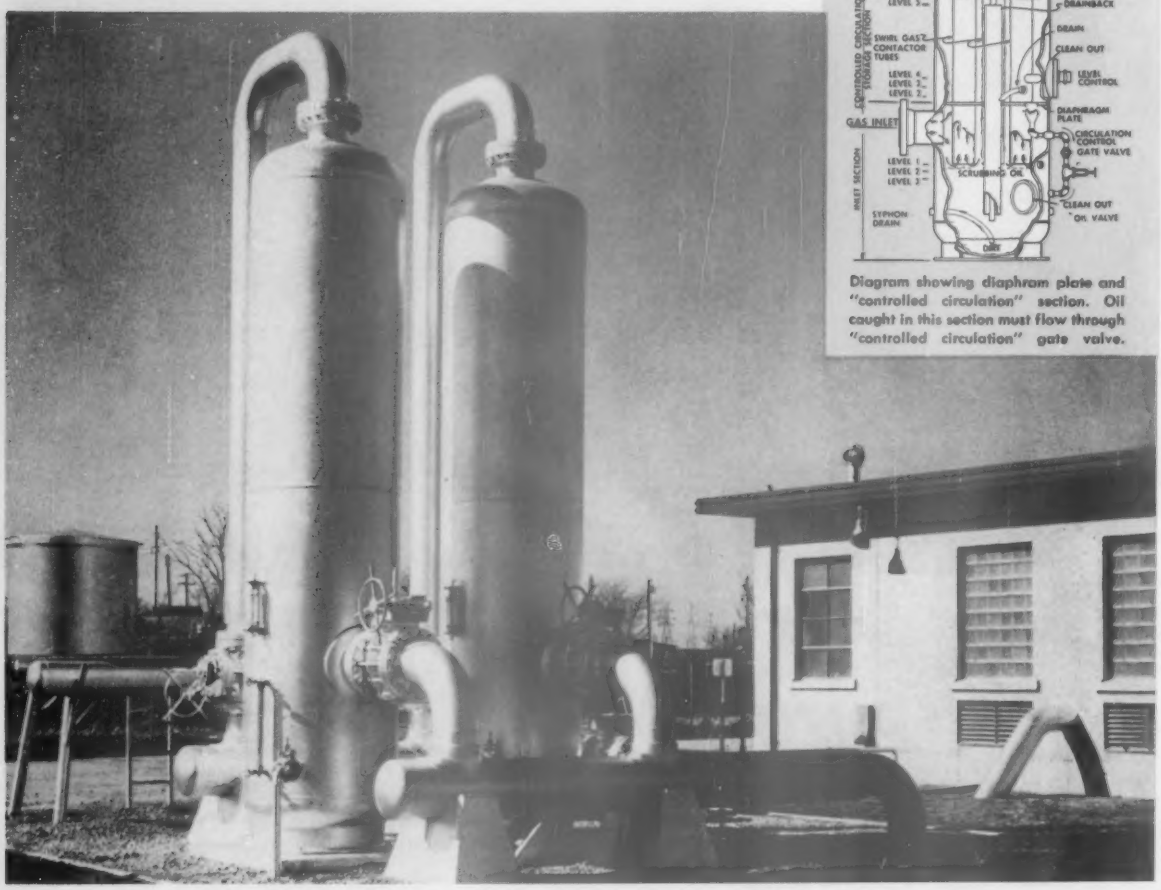


Diagram showing diaphram plate and "controlled circulation" section. Oil caught in this section must flow through "controlled circulation" gate valve.



More efficient liquid and dust removal is provided with Peerless "Controlled Circulation" Vertical Swirl-Gas Cleaner

With given gate valve setting, circulation of scrubbing liquid varies within narrow range even with widely varying gas flows . . . thus greatly reducing scrubbing oil loss. Scrubber will remove small quantities of dry solids or separate large quantities of liquid equally well with no adjustments required. In addition there are higher gas capacities because of limited mist extractor loading, less entrainment at gas exit end of contractor tubes, and use of larger mist extractor.

For details, Write for Peerless Bulletin 6-193.

Write today for information on the new color film, "Engineering Makes the Difference", showing various applications of Peerless separators, engineering, testing, and manufacturing facilities.

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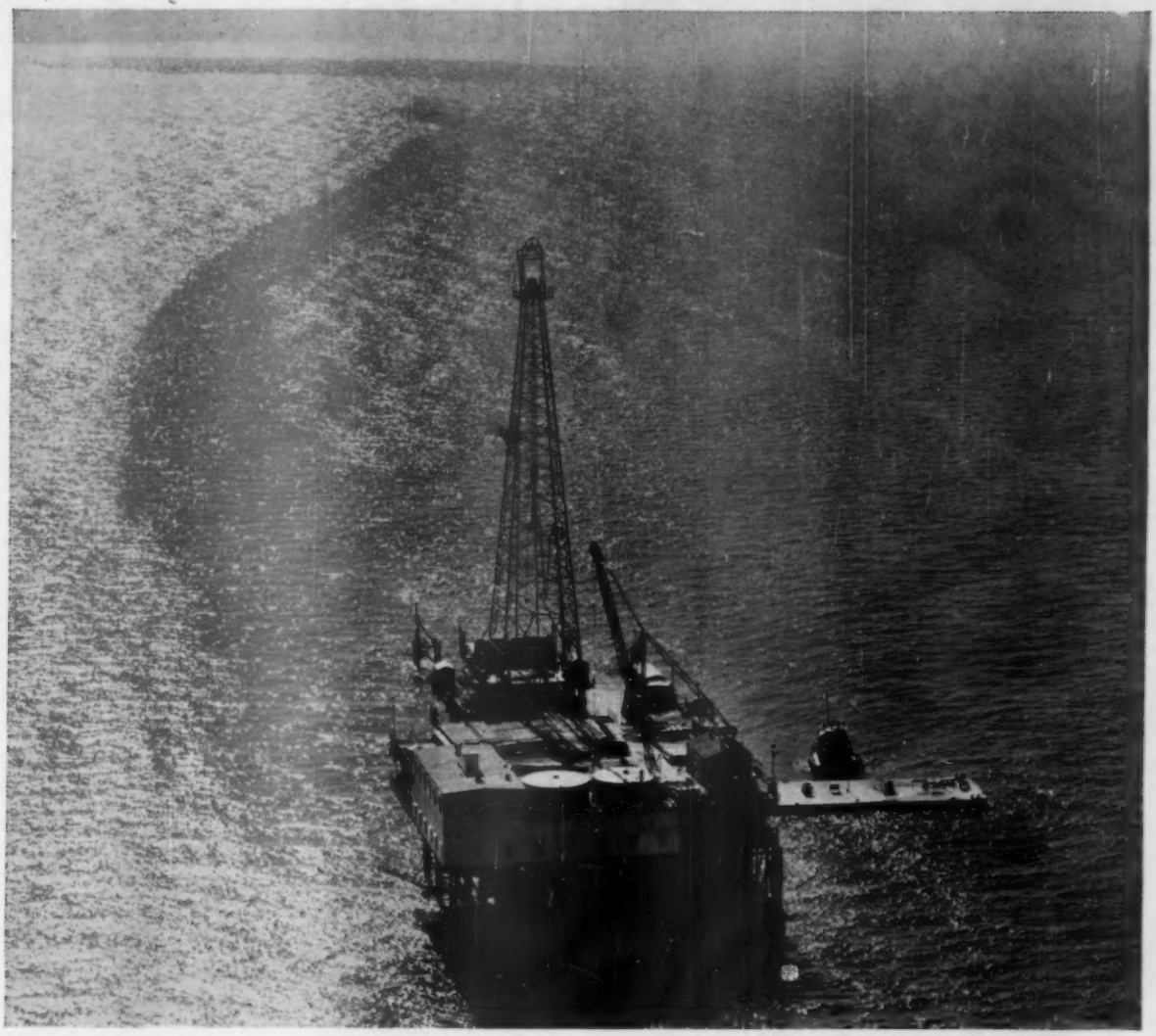

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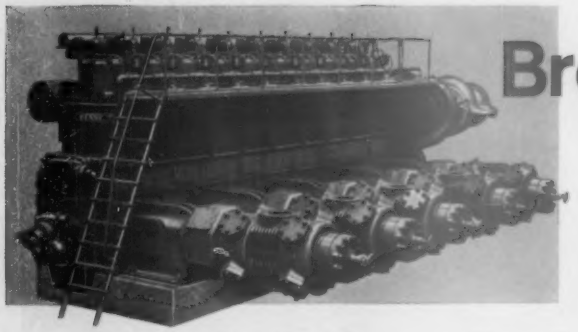
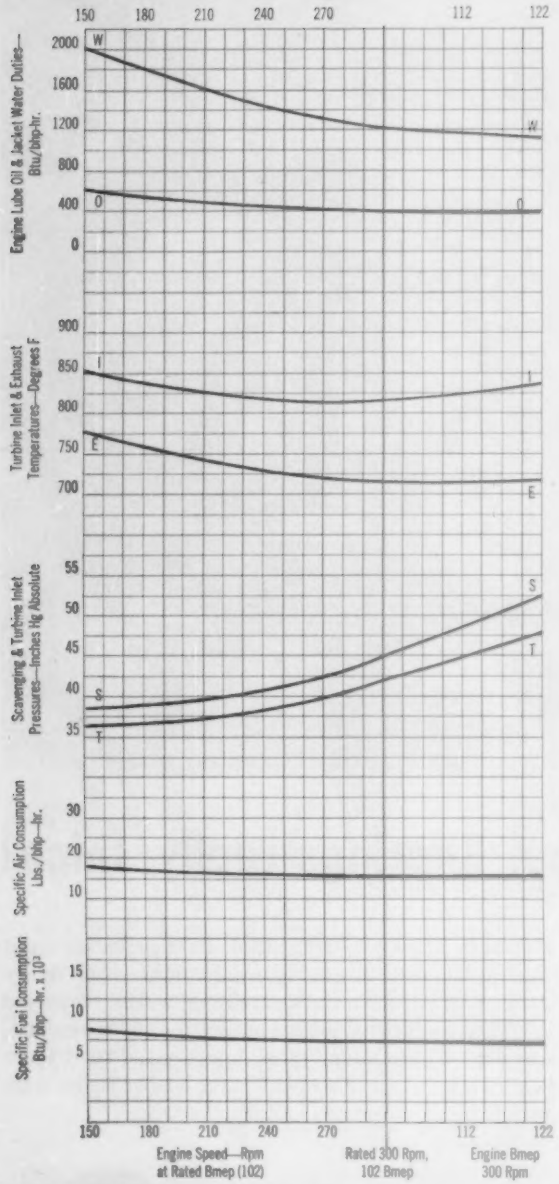


Breakthrough in two variable speed,

Automatic ignition timing plus automatic turbocharger control provide unrivaled speed, load and response characteristics.



Performance curve of Clark Model TLA turbocharged, 2-cycle, gas-engine-driven compressor. Unit features 17"x19" bore and stroke. Rated speed is 300 rpm. Rated bmep is 102 psi. Note the remarkable parallel between the fuel consumption and specific air consumption curves.

Q. What makes two cycle engines so well suited for variable-speed, variable-load applications?

A. It has long been traditional to consider two cycle engines as good prime movers for applications where power and speed are maintained close to 100% of rated load and speed. This may have been true a number of years ago when two cycle engines were single and twin horizontal designs. But the situation began to change with the introduction of vertical, multicylinder machines with direct fuel injection. Subsequent addition of constant pressure turbocharging and automatic ignition timing control have made two cycle performance equal or superior to four cycle engines in acceleration and in response to load or speed changes. Regardless of how fast the load or speed changes, the two cycle engine is able to adjust more rapidly because it fires twice as frequently. As a result the actual amount of load change between successive firings is cut in half, all other conditions being equal.

Q. Why has turbocharging caused such a vast improvement in two cycle engines?

A. The Clark system of constant pressure turbocharging permits variation of scavenging air flow with load to maintain relatively uniform air/fuel ratios over the complete operating range. This variable air supply plus maintenance of optimum ignition timing enables Clark engines to achieve excellent performance from substantial temporary overloads at rated speed down to the usually recommended 50% speed at constant torque.

Q. Why is constant pressure turbocharging so effective?

A. In general, all turbocharged engines are arranged to achieve best efficiency and fuel consumption at a particular design point—usually rated load. The Clark system of constant pressure turbocharging, however, is inherently capable of maintaining optimum efficiency not only at design point, but over an extremely broad operating range as well. The reason: *Clark turbocharging provides a flexible supply of combustion air that varies in direct proportion to load.* It does not depend on pulses of exhaust gas or on engine driven blowers, hence is free to provide the exact amount of air demanded by the engine. At light loads, there is neither a fall-off in performance nor any "lean out" problem arising from too much air. With increased loads, the turbocharger is able to pump increasingly more dense scavenging air into the power cylinders. There is no element in the

cycle compressor performance for variable load applications

system to impede or interfere with the performance of the turbocharger as it responds to the higher power requirements. Thus the fuel/air ratio remains constant through the entire operating range for best engine performance.

Q. Are there other important advantages of the Clark Constant Pressure Turbocharging system?

A. Yes. In addition to efficient combustion, the large amounts of available scavenging air have a cooling effect on the cylinder walls, cylinder heads and piston heads. Possibility of detonation is minimized, better lubrication is assured, and the temperatures of the exhaust gases are controlled as they enter the turbocharger. The cooling effect of the excess scavenging air is especially advantageous at high ambient temperatures. It lowers overall cooling duty and enables the Clark intercoolers to provide adequate scavenging air cooling. There is no need to resort to evaporative cooling of air or other special means of preventing detonation and cylinder wear.

Q. How does Clark achieve such good low speed lugging characteristics?

A. With Clark turbocharged, two cycle engines, compressor capacity can be most easily and efficiently varied by adjusting speed while maintaining at or near rated load torque. *The engine-driven compressor is then operating at rated load all the time, at which condition it functions most efficiently.* The exceptional low speed lugging characteristics are due primarily to frequent power impulses that reduce cyclic speed variation. At low speeds, cyclic speed variation is always accentuated because flywheel inertia is reduced in proportion to the square of speed reduction, and power impulses become less frequent with respect to time. Thus the two cycle engine has a great advantage because each cylinder fires every revolution.

Q. How do Clark two-cycle engines perform under overload conditions?

A. A glance at the chart showing actual test data taken from a Clark turbocharged Model TLA gas-engine-driven compressor demonstrates graphically that the fuel consumption curve is remarkably flat over a wide range. When operating as high as 20% overload under emergency conditions, Clark engines actually burn *less* fuel per bhp than at rated load. Even more important is the manner in which the specific air and specific fuel consumption curves parallel each other perfectly over the entire range. This illustrates the inherent advantage of Clark "true" turbocharging system. Once the engine is started and the turbine is self-sustaining, the turbocharger adjusts itself freely and almost instantaneously to the demands of the engine.

Q. How does ignition timing control improve operating performance?

A. There are two conditions in which ignition timing control is used with the Clark system: At startup and at reduced speeds. During the starting cycle, the timing control automatically adjusts the ignition to increase the flow of heat to the turbocharger. This shortens startup time and substantially reduces consumption of starting air.

At reduced speeds (i.e. from 50% to 80% rated speed), the ignition is automatically regulated to maintain optimum ignition timing consistent with the rate of pressure rise in the cylinder with respect to time. Thus the peak pressure is reached at or near top dead center and expansion of the burned gases takes place most effectively with less tendency to detonation.

Q. What is the net effect of combining turbocharging with two-cycle engines?

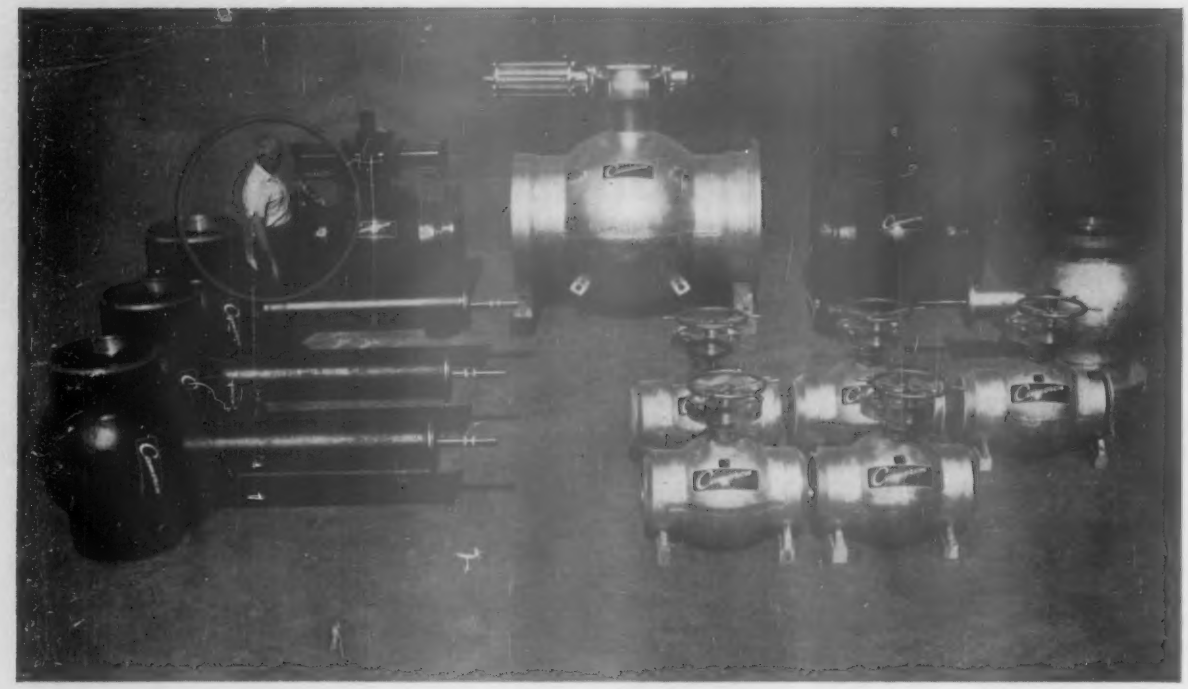
A. The user enjoys all the advantages of a two-cycle engine —simplicity, fewer moving parts, greater dependability— plus the advantage of turbocharging—more power in less space, better fuel economy, greater operating flexibility. Clark two-cycle gas-engine-driven compressors are very conservatively rated. Lower bmep eliminates the ignition difficulties and fouling tendencies common in higher rated machines. There are no large exhaust or intake valves to warp, pit or burn. Two-cycle design keeps continuous downward pressure on the power pistons, thereby eliminating oil "pumping." There is no piston ring blowby, the cause of sludging and crankcase oil dilution. The two-cycle engine is less sensitive to detonation under high ambient temperatures. Thus Clark design reduces costly maintenance and assures more profitable "uptime."

Q. In what type of application is Clark capacity variation with speed useful?

A. Pipeline gas transmission where there are few units in a station. Process applications employing gas engine drivers. Gas distribution boosters where the compressors are located near sales outlets. Manufactured gas compressors. Field gathering compressors where few units can be economically employed and wide variation in gas supply is expected.

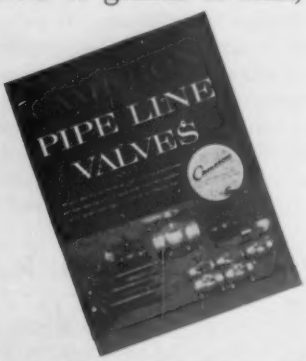
For more details on how Clark variable-speed, variable-load performance can help you, contact your nearest Clark office or write to:

CLARK BROS. CO., OLEAN, N. Y.



ACCEPTED BY PIPE LINES

Cameron Ball Valves are winning increasing acceptance by pipe line companies the world over. The companies like the compact design, the simplicity and the light weight in comparison with conventional valves. Cameron Ball Valves are easier to handle and easier to coat than conventional valves. There are no bonnets or glands to leak, and no lubrication is required either for sealing or to reduce friction in operating the valve. Torque required to operate the valve is amazingly low because the pressure of fluid against the ball is carried by low friction Teflon bearings, and the seat ring area in contact with the ball is small. A tight shutoff for countless operations is insured by the rotating seat design.



Ask a Cameron representative or write for a pipe line valve catalog.

CAMERON IRON WORKS, INC.
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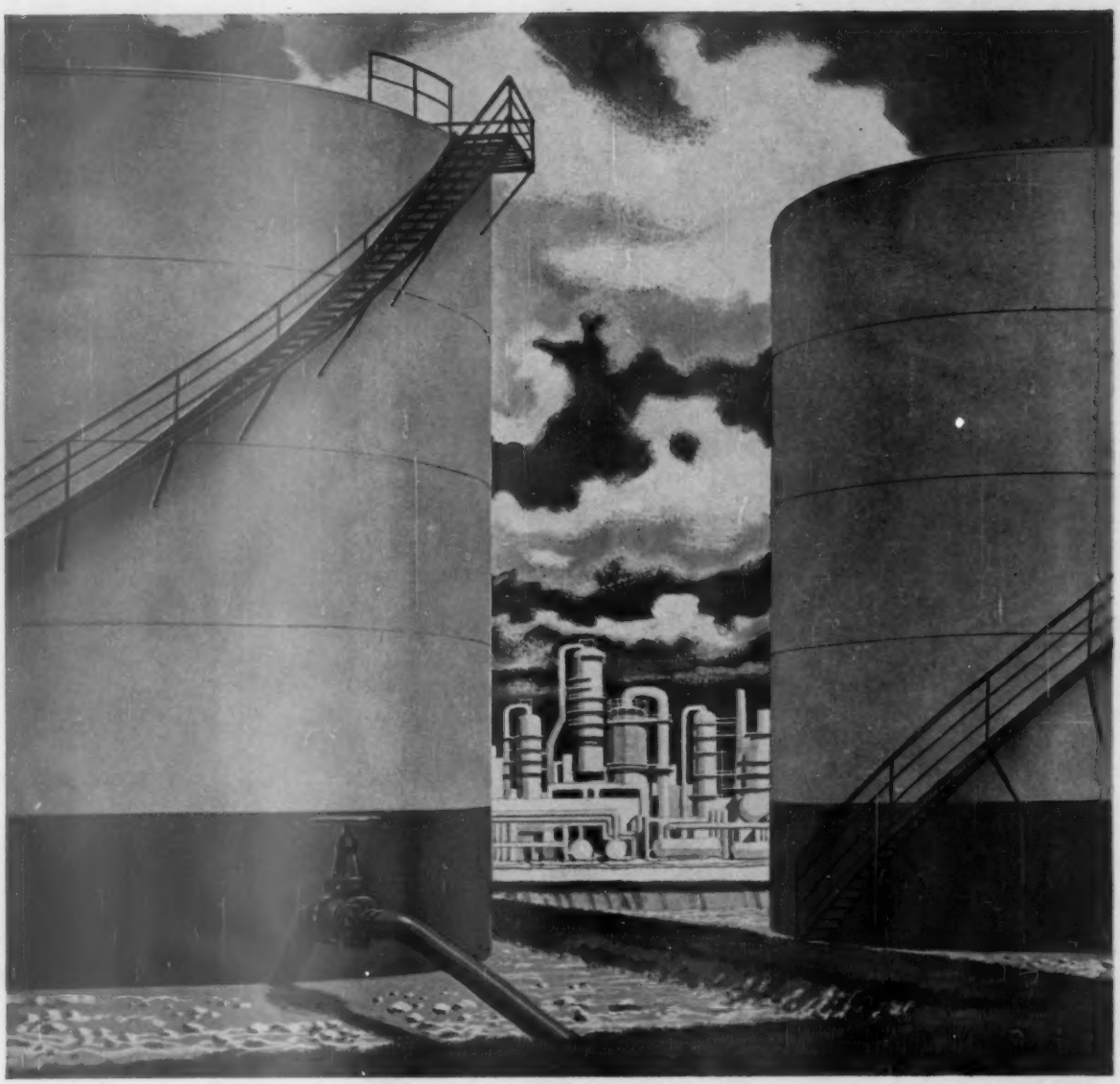
CAMERON BALL VALVES



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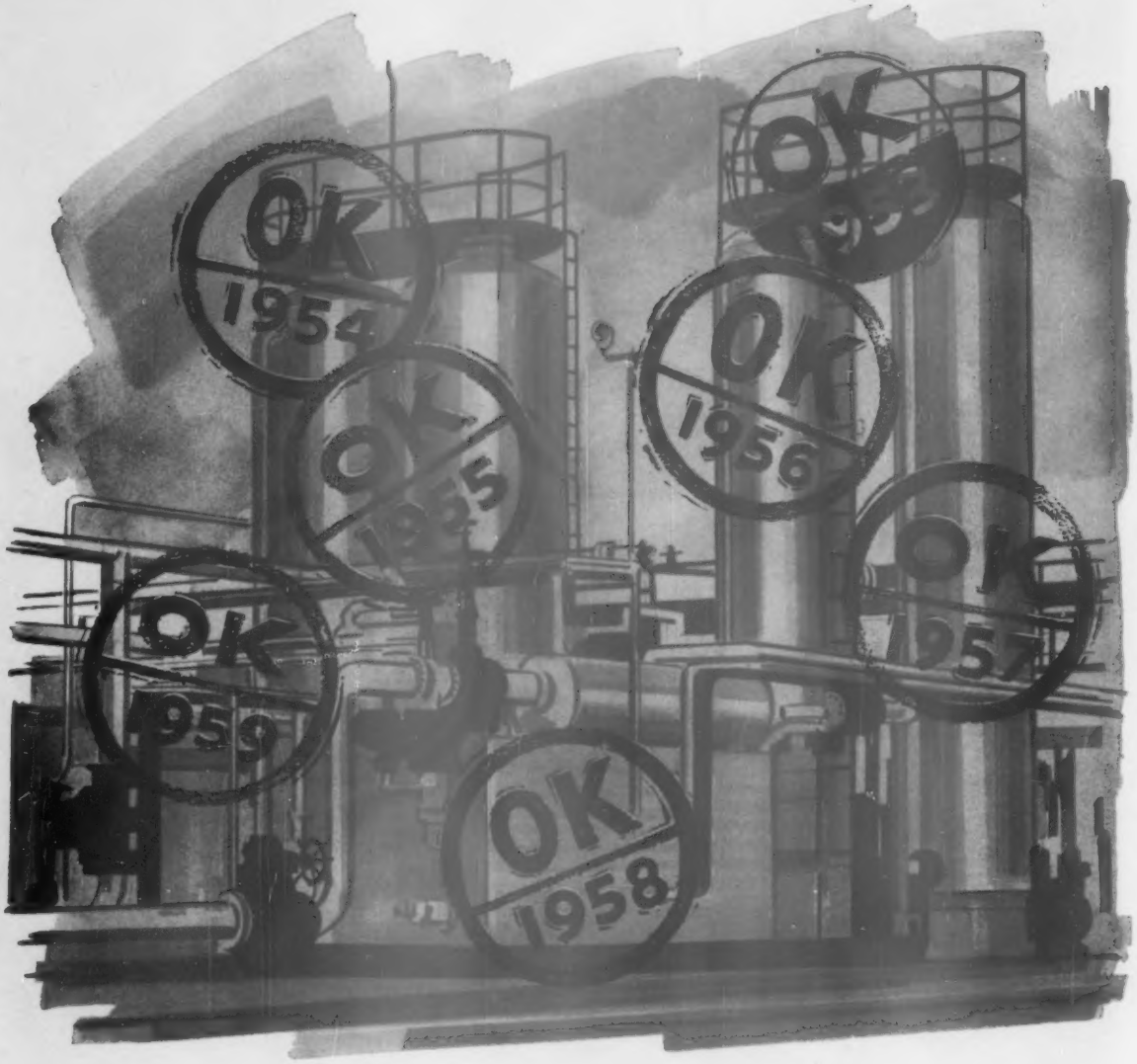

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and Davison Silica Gel still meets required dew point

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GRACE

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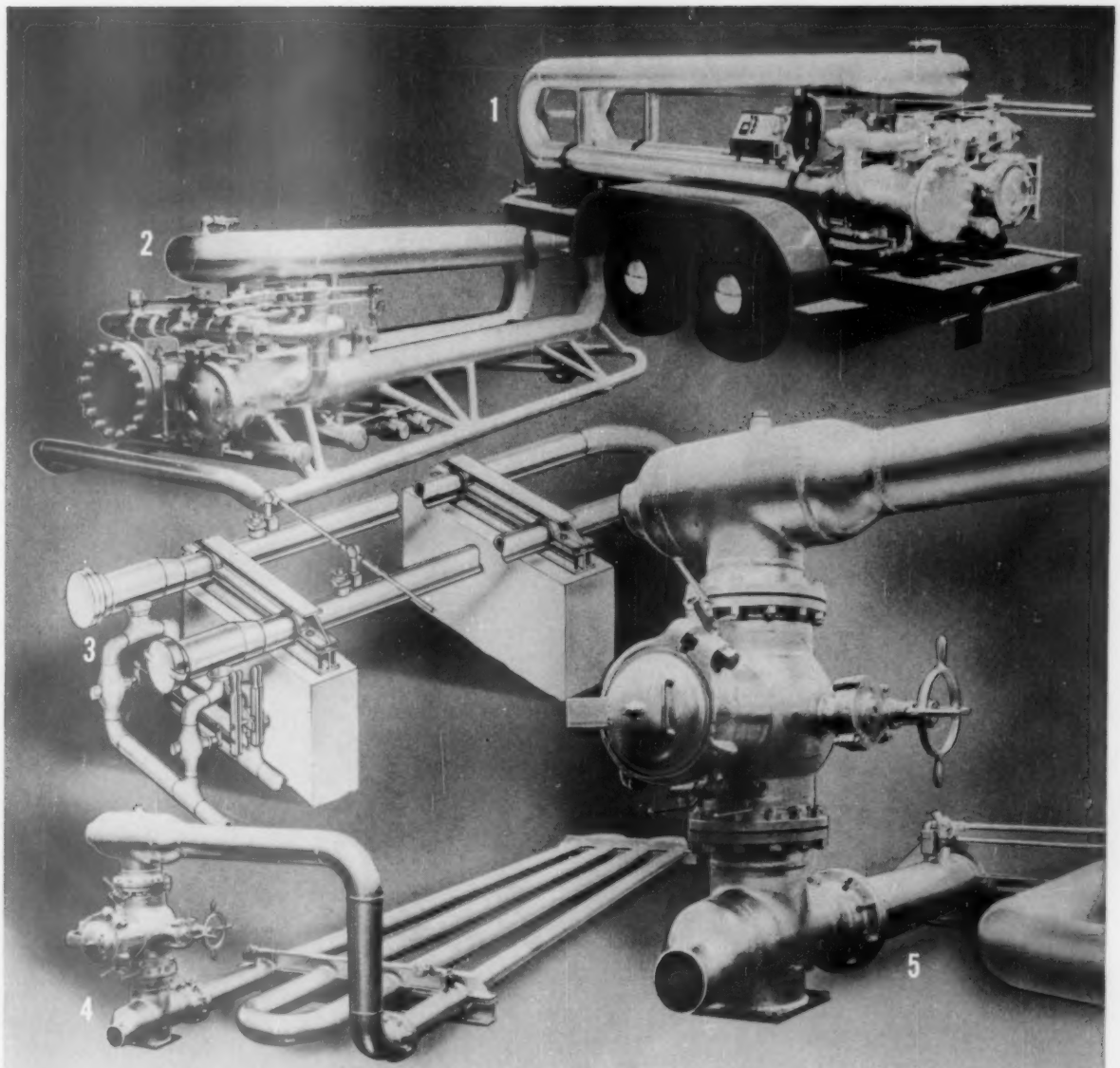

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The units illustrated are standard models. However, larger units may be specially engineered to fit a customer's particular need. For additional information on all Maloney meter provers, please write the Company's Houston office for Bulletins MP-1 and MP-2.

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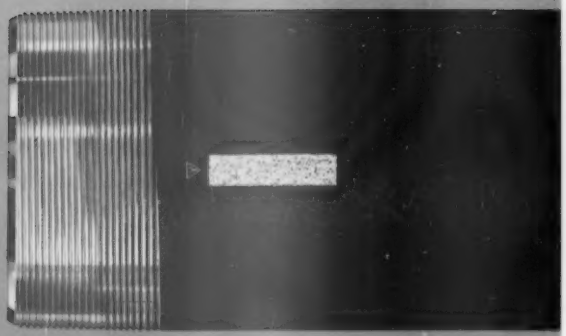
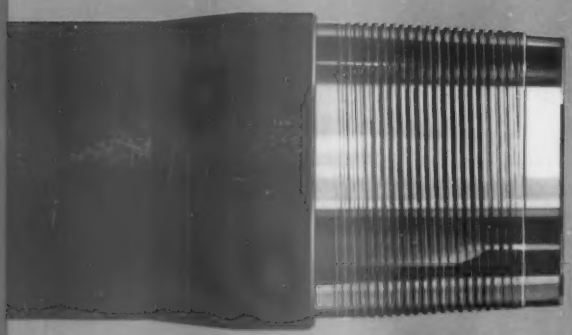
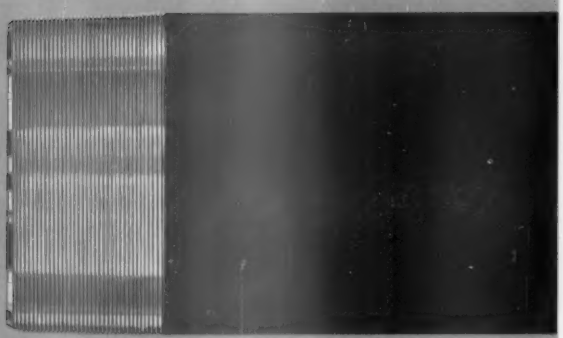


BUTTRESS



EXTREME LINE



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Get Youngstown seamless casing in all weights from 4½" through 13⅜" O.D. API (long or short) T&C in H-40, J-55, N-80, and P-110. Or specify Youngstown's Buttress T&C, Extreme Line and Speedtite integral joints in J-55, N-80 and P-110.

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RETARDED ACIDS — slow-acting acids designed to penetrate deeply before spending. They are used to improve production from fast-reacting, vugular, oolitic, or naturally fractured formations.

MUD ACID — a special acid solution that dissolves and disperses mud on screens, liners, perforations and the pay. It also increases permeability of certain sand formations which have low solubility in regular acid.

BDA* BREAKDOWN ACID is designed to penetrate and disperse mud cakes by reducing surface tension, by preventing and breaking emulsions and by removing water blocks. It is often used to break down formations ahead of fracturing, cementing and conventional acidizing treatments.

SILICATE CONTROL ACID has special agents added to prevent the swelling of clay minerals and other formation silicates. It also prevents or breaks certain emulsions.

STABILIZED ACID contains an additive to prevent the formation of formation-plugging iron hydroxide precipitate. Many troublesome water injection wells have been successfully treated with Stabilized Acid.

ADDITION AGENTS are available to reduce surface tension, prevent or break emulsions, remove or prevent the formation of compounds that might plug the formation, and speed up or slow down acid reaction with the formation.

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THE ACID GUIDE* — Dowell's method for planning and predicting the results of acidizing treatments — helps operators get the most profitable treatments for their wells.

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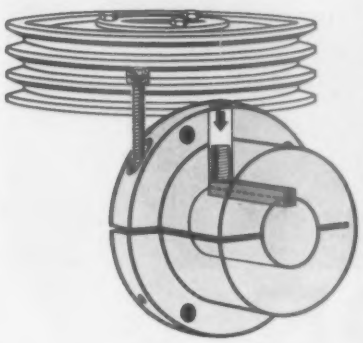
DIVISION OF THE DOW CHEMICAL COMPANY

"AND THEN THE KEY CAME LOOSE..."



"Well, the key broke a window—it could have killed someone. A shaft was scored . . . the loss of drive power resulted in a loss of material . . . over $1,000 . . . we had to postpone deliveries 4 days." Frankly, this plant manager had it rough . . . though it could have been a lot worse, too. But he could have avoided the trouble completely by using Worthington sheaves that have the Two Golden Screws.

The Golden Clamp Screw at the left is an exclusive Worthington feature that locates and locks the hub securely on the shaft, permitting you to tighten the set screw without distorting the hub. And note that the two-piece hub-and-rim design simplifies installation. You install one piece at a time—or change sheaves without disturbing the hub or affecting the alignment.

The Golden Screw on the right is the set screw that turns down to lock the key securely in place. It prevents potentially damaging key drift. There's no extra cost for the set screw but it is worth its weight in gold for the safety it provides.

These Worthington hubs are standard in three major Worthington drive systems: the new, money-saving, more compact Multi-Wedge Drive; the standard Multi-V Drive and the Positive Drive. Ask for one or more of the "how-to-figure-it" design manuals shown here. Your local Worthington distributor stocks these products. He's listed in the Yellow Pages. Or write Worthington Corporation, Section 79-42, Oil City, Pennsylvania.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

LINE PIPE BY NAYLOR

Distinguished by the Lockseamed-Spiralwelded structure.

Provides light weight without sacrifice of strength.

Simplifies handling and installation.

Assures extra collapse strength.

Absorbs shock loads, stresses and strains.

Furnished in diameters from 4" to 30"—pipe ends of standard weight thickness available.

Write for Bulletin No. 59 or call our distributors.

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EXCLUSIVE DISTRIBUTORS IN MID-CONTINENT AND GULF COAST AREAS: **MID-CONTINENT SUPPLY CO.** • Fort Worth, Texas and Branches

Nash Compressors Tame "Hard-to-handle" Corrosive Gases

The reasons for the success of Nash Compressors in handling "dirty" and corrosive gases are simple. First, Nash Compressors have no internal parts in wearing contact, or requiring close tolerances and internal lubrication. Second, because of the Nash operating principle, a variety of liquids can be employed as the compressant medium, protecting the interior from corrosive action. Third, the pump casing may be fabricated from a variety of special metals and alloys. That is why Nash Compressors take these rugged jobs in stride.

Nash Vacuum Pumps offer the same basic advantages when handling corrosive gases, and reliably maintain vacuums up to 29.50 inches of mercury.

Shown here is the new Nash H-10-G, capacity 2040 cubic feet per minute. This is equipped with the new gear reduction drive, giving great flexibility of installation, and permitting the use of stock motors.

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ACETYLENE
AMMONIA
ARGON
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SULPHUR GAS
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AND MANY OTHERS

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NEW LOOK
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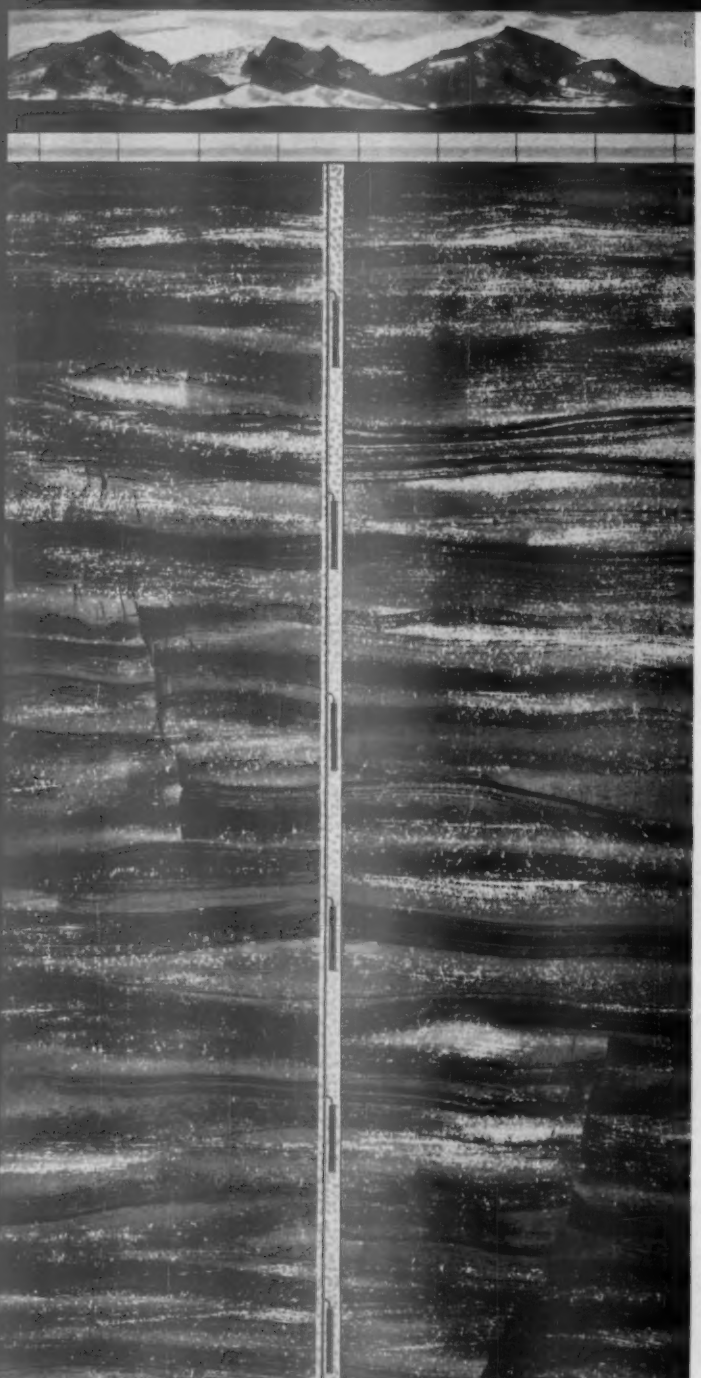


for "deep well"
installation, specify

Duriron®
impressed current
Anodes

Durco high silicon iron alloys (Duriron, Durichlor, and D-51) are being used almost exclusively for new deep well anode installations.

Durco anodes combine the advantages of:

1 PERMANENCY *(Weight loss 1/20 of that of steel)*

2 EASE OF INSTALLATION *(Bulk volume of scrap steel is avoided)*

3 MINIMUM TOTAL COST *(No backfill or pre-packing of anodes required)*

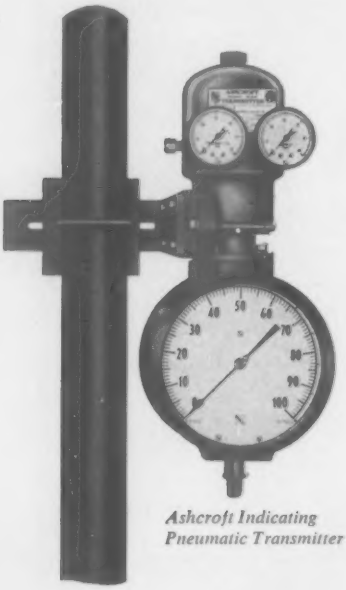
Durco high silicon iron alloys are resistant to sea, brackish, and fresh waters, as well as all soil environments. Complete details are contained in Bulletin DA/6.

THE DURIRON COMPANY, INC.
DAYTON, OHIO

DURCO

signal

ASHCROFT PNEUMATIC TRANSMITTERS give you
a true primary and transmitted signal for indication or control



Ashcroft Indicating Pneumatic Transmitter

action

Now—detect with precision accuracy the slightest change in primary pressure or temperature. Transmit this signal quickly to your indicators or controllers. Ashcroft Pneumatic Transmitters do the job at lowest initial and operating costs.

Full-range, solid-front indicating and totally accessible nonindicating transmitters need no costly high-pressure lines, yet permit complete monitoring of processes in remote areas. For safety's sake, you get full indication even if the air is shut off.

Narrow-span Ashcroft Transmitters are expressly designed with highest sensitivity and repeatability for the most accurate primary signal feed to controllers. You get better control and purer, lower-cost final products.

Only in Ashcroft Pneumatic Transmitters can you get the wide choice of Ashcroft Duragauge Bourdon tubes or American mercury or gas-actuated sensing systems. You also get a time-proven, obstructionproof, force-balance, non-bleed replay for economical, maintenance-free 3-15 psi or 3-27 psi signal transmission. Both indicating and nonindicating *suppressed* types available.

Write for factful Bulletins 360 and 361 or ask your nearby Ashcroft Distributor to help you select the right transmitters and receiver gauges.

MANNING MAXWELL & MOORE INC. TRADE MARK

ASHCROFT PNEUMATIC TRANSMITTERS

A product of

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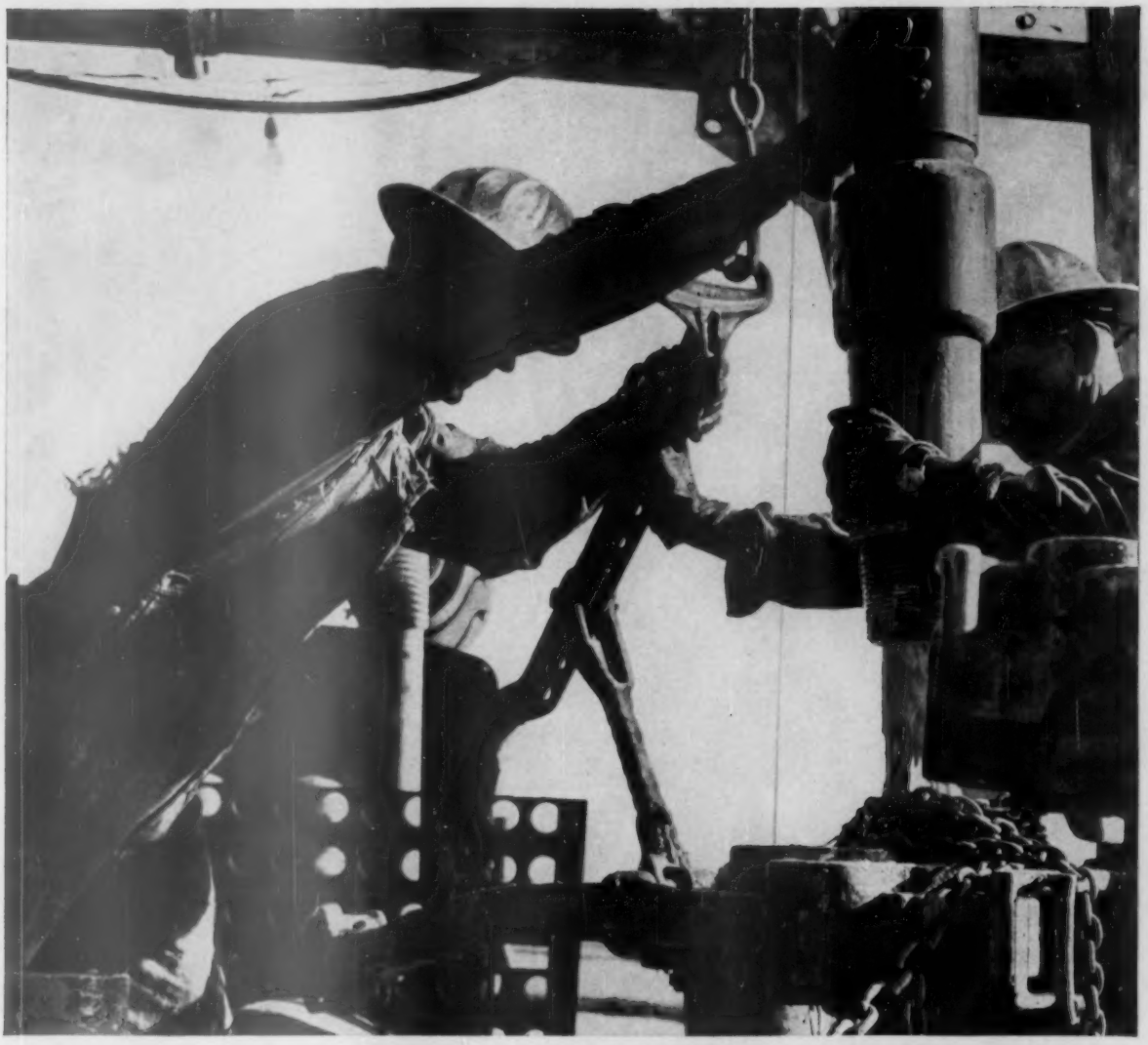

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We're one of the biggest and most active oil banks in the country. Through experience with ventures of every type and description, we've a knowledge of oil financing that will enable us to tailor a sound, constructive plan for you.

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For a higher yield per dollar—Aerocat Triple A

Why more and more refineries are increasing efficiency and cutting costs with this 25% Alumina Catalyst. AEROCAT TRIPLE A® Cracking Catalyst, the first commercially successful 25% alumina catalyst, is still setting records. Its combination of extremely high activity and unusual stability provide premium cracking efficiency, high equilibrium activity, increased conversion at lower temperatures, or (compared to conventional, low alumina catalysts) reduced catalyst usage at severity levels.

Yet, with all its efficiency, AEROCAT TRIPLE A can actually save you money, compared to other synthetics of comparable performance—particularly where low catalyst turnover is possible. It yields *more* gasoline; it measurably increases octane rating, and with no increase in stack losses of the catalyst itself. The increased output takes place at the expense of a lower dry gas yield.

Isn't it time you investigated what AEROCAT TRIPLE A can do for *you?* Your Cyanamid salesman—"The Man with the Golden Rule"—will be glad to cooperate, for sharing his skill and experience with refiners is a most important part of his job. Why not call him *now?*

Basic in catalyst chemistry

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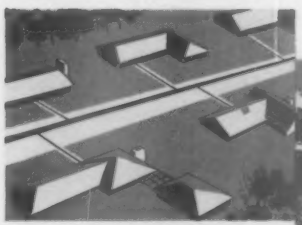
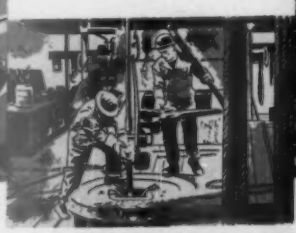
High strength . . . quality engineered Southwestern Lightwall saves important dollars when used in place of standard-weight pipe. At Southwestern, a continuous process of improvement upgrades pipe performance . . . in engineering, design, materials and manufacture. Average quality is not good enough—Southwestern demands the best, then finds ways to make that even better.

If profit and dependability are important . . . Specify Lightwall by Southwestern.

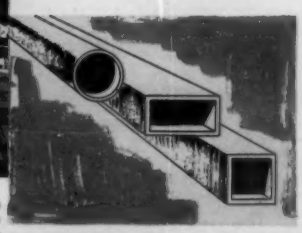


Southwestern Lightwall for mains and laterals in gas distribution systems to homes and industry.



Southwestern integral joint and non-upset E.R.W. oil country tubing for multiple completions and slim-hole drilling.

Southwestern Lightwall line pipe to keep oil and gas on the move in gathering lines—pipelines—waterflood projects.



Southwestern structural pipe and mechanical tubing for a thousand uses in industry, construction, furniture manufacture, fences, metal buildings. Round, rectangular, square and other shapes.

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LICENSED BY THE AMERICAN PETROLEUM INSTITUTE

Improved Kellogg Techniques Provide Increased Creativity in New Plant Design . . .

1 Many of the computer programs in Kellogg's extensive library have been developed jointly by process engineering and computer specialists.

More efficient engineering and sounder new plant investments will result from use of a new high-speed IBM 7070 computer installed at The M. W. Kellogg Company's headquarters in New York.

The new computer and improved programming techniques mark another major stride in Kellogg's continuing improvement of its engineering services. Its speed makes practical rigorous calculation and the evaluation of multiple solutions to difficult design problems—a vital step in achieving the most economic design.

The computer's large capacity will enable Kellogg to develop new methods which can be applied to plant engineering problems. In addition, it will permit Kellogg to broaden its present activities in such areas as computer control, process dynamics, and systems engineering.

New engineering techniques and increased engineering efficiency are vital to the creation of optimum plants. If you are planning a new plant, Kellogg engineering services, more than ever, can help you achieve optimum plant design and a more economic investment.

2 Engineering data and computer commands, punched on cards and stored on magnetic tape, are read into the computer.

3 A printout provides engineering data ready for evaluation. Simplified methods permit ready use of computer for solving a wide range of process and mechanical design problems.

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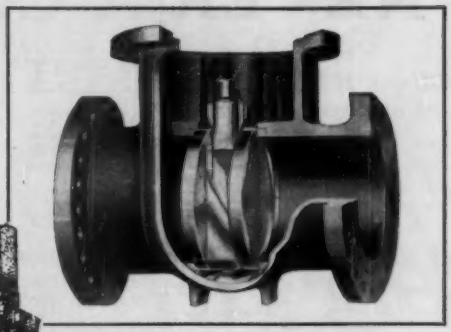

Cutaway shows the extreme simplicity of Darling's unique fully revolving double disc parallel seat gate valve principle.

YOU CAN DEPEND ON

Darling

For long-range economy on pipelines, standardize on Darling cast steel gate valves. The fully revolving double disc parallel seat and wedge construction automatically compensates for valve seat distortion, distributes disc and seat wear uniformly, and minimizes friction. These valves open fully and close easily even under severe pressure loads and radical temperature changes. *You can depend on Darling!*

The four working parts can be replaced without removing the valve from the line. You save valuable time when, after extended operation, it becomes necessary to service the valve.

Write, wire or phone for detailed information on Darling gate valves—available in pressures and constructions for main and gathering lines, tank farm and other services.

DARLING VALVE & MANUFACTURING COMPANY

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Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario, Canada
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GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS

NEVER A COMPROMISE WITH TUBE-TURN® PIPELINE FITTINGS

Exactly what you need...

Exactly when you need it!

Why compromise in pipeline design? Choose the exact pipeline components you need from Tube Turns' 12,000 standard fittings and flanges and pipeline specials such as 3R elbows, scraper bar tees, insulating flanges, manifold fittings, hinged closures, and many others.

Why compromise in pipeline construction? Your Tube Turns Distributor will fill all your pipeline component needs on a single order . . . no red tape, no delays. Tube Turns' prompt service keeps your construction timetable on schedule.

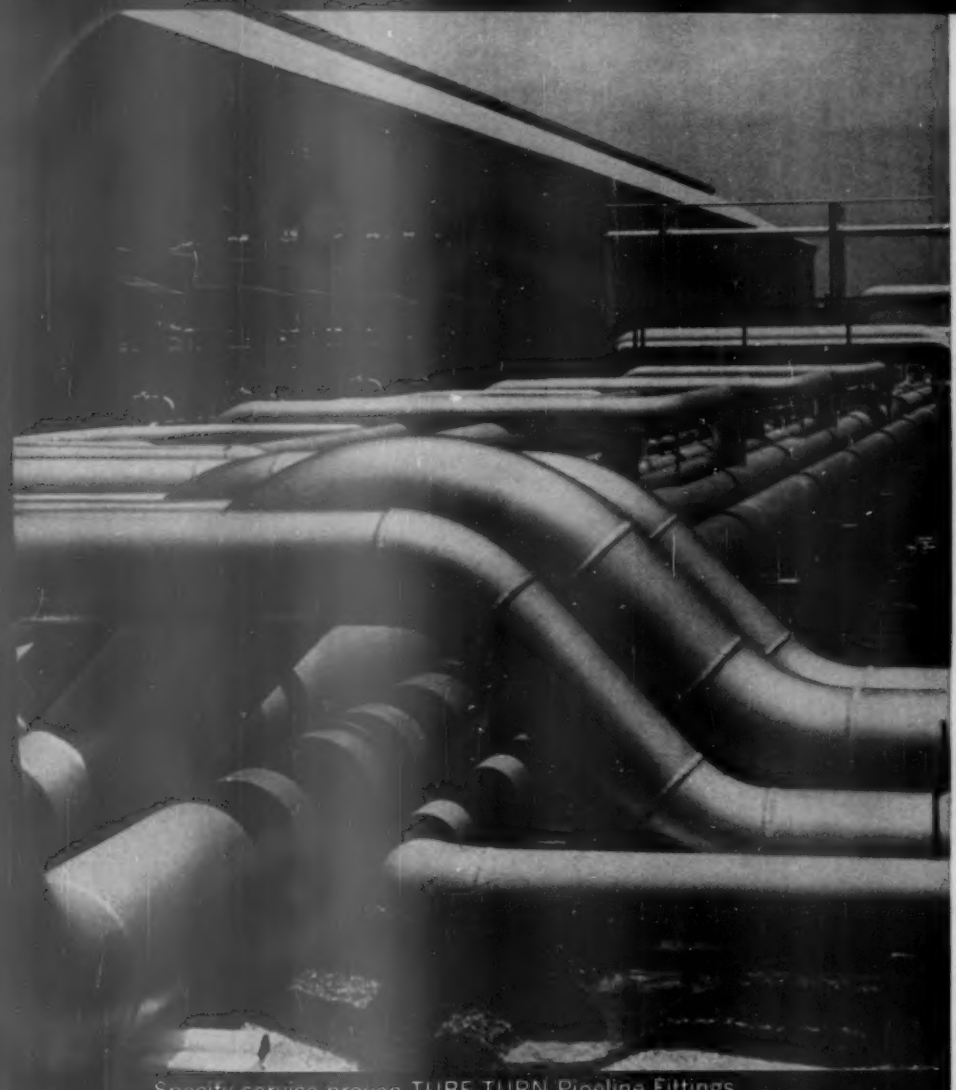
Why compromise in pipeline performance? To get all the performance you designed into your pipeline, make sure TUBE-TURN quality goes into the job, not merely into the design specs. Tube Turns Distributors and responsible contractors are glad to give you this assurance with an affidavit that states they have met your specifications to the letter.

Standardize on TUBE-TURN Pipeline Fittings now, and look for the famous "tt" trademark when you buy. It's your guarantee of quality . . . the mark of *known* value. Write today for TUBE-TURN Pipeline Fitting selection guide . . . ask for Bulletin TT638-J218. TUBE TURNS, Louisville 1, Kentucky.

"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

TUBE TURNS

Division of CHEMETRON Corporation



Specify service-proven TUBE-TURN Pipeline Fittings . . .

Hinged Closures

Venturi Reducers

Anchor Forgings

Pig Diverter Laterals

Full-Encirclement Saddles

TUBE-TURN Pipeline Fittings Are Stocked By And Sold Exclusively Through Authorized Distributors

KNOWN VALUE

LIFESAVER For The Men Who Design Piping

Tube Turns offers not only the most complete line of properly engineered pipeline components for utmost design flexibility, but a wealth of technical data and able engineering assistance without counterpart anywhere in the world. Standardizing on TUBE-TURN piping products saves time and trouble.

KNOWN VALUE

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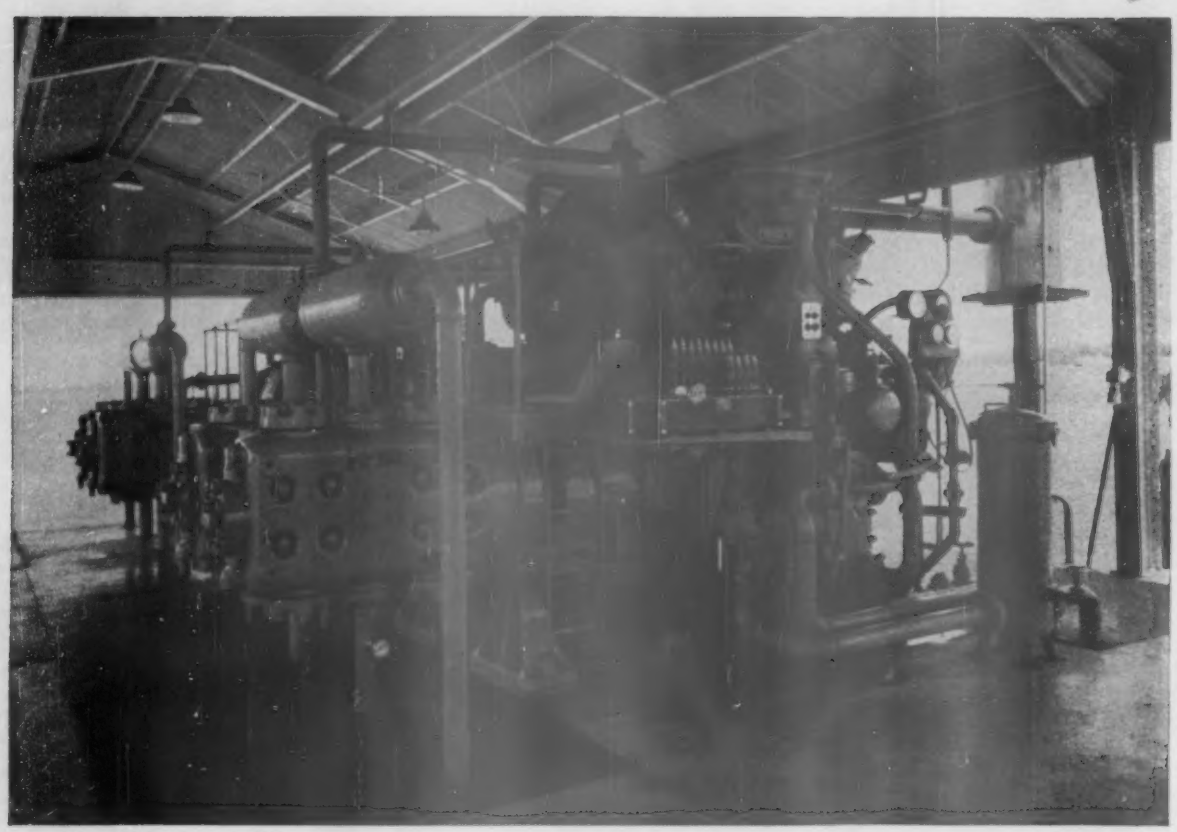
The world's most complete line of welding fittings and flanges, over 12,000 regularly stocked TUBE-TURN items, permits every specification to be met without compromise or delay. A fully responsible Tube Turns Distributor is as near as your telephone to give prompt delivery of *all* your needs from *one* source on a *single* order. Saves time, paperwork, multiple checking, piecemeal deliveries and the inevitable problems of divided responsibility. You *save* money when you standardize on TUBE-TURN piping products!

KNOWN VALUE

LIFESAVER For The Men Who Install Piping

Time is money in pipeline construction. TUBE-TURN Pipeline Fittings do not require remanufacture or compromises . . . or the delays that result from rejections. They are uniform, precision-engineered for easy, time-saving installation. And you can put them in and *forget* them because they *are* dependable. TUBE-TURN piping products cost less because they save more in every way!



MORE PUMPING TIME, LESS DOWNTIME...

Ambitrol coolants protect against freezing and corrosion

DOUBLE PROTECTION against industrial engine downtime is now available through two new Dow products—Ambitrol* FL and Ambitrol CN coolants. In addition to affording complete freeze protection, Ambitrol offers two methods for combating the widespread problems of local water hardness and corrosiveness.

Ambitrol FL industrial cooling system fluid completely fills the system, requiring no dilution—problems with local water conditions are eliminated. This product is designed to provide freeze protection for industrial cooling systems down to –40° F., with protection against overheating up to a temperature of 240° F.

Since inhibitor depletion can still occur in any cooling system due to extremely severe operating conditions, leakage, etc., Dow provides a further protection with the Dow *Cooling System Maintenance Program.* This is a product analysis service in which periodic samples of the Ambitrol in use are sent to the Dow Industrial Coolants Laboratory. Reports on these samples are returned to the user and contain full information for servicing to maintain both freeze protection and inhibitor effectiveness.

Ambitrol CN is a freeze-depressant concentrate which is blended with local water at the site. Its inhibitor system offers superior protection against damage from corrosion even in the many varieties of water throughout the United States. As with Ambitrol FL, users of Ambitrol CN can participate in the benefits offered by the Dow *Cooling System Maintenance Program.*

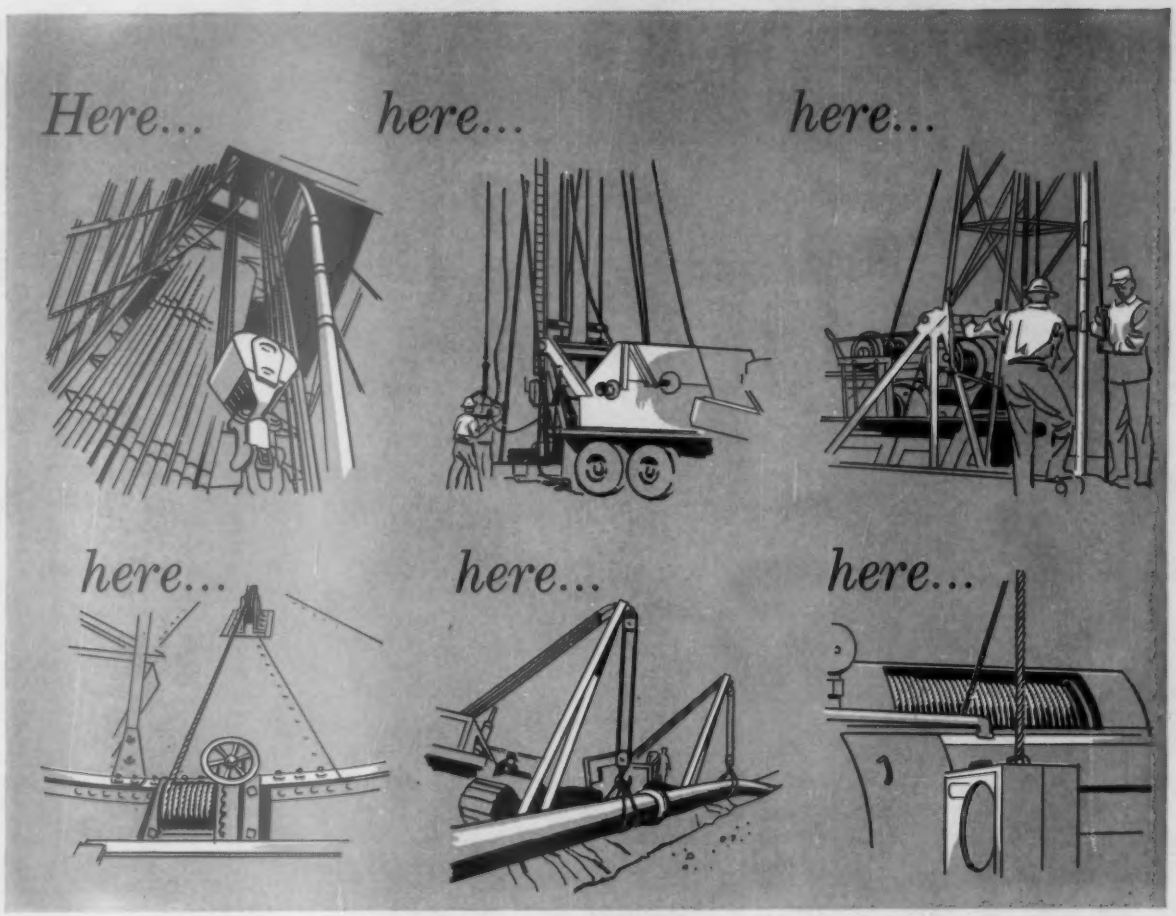
Ebullient cooling has solved many of the problems of bigger and more powerful engines, new alloys, and closer tolerances that impose exacting demands for uniform engine temperature control. Ebullient cooling, one system designed to control temperature within a narrow range, is gaining in interest and use. The system calls for chemical compounds radically different from those used in conventional cooling systems. From its continuing research, The Dow Chemical Company developed Dowtherm® 209 coolant to meet these new demands for uniform engine temperature control. Today, Dowtherm 209 is used by many stationary engines having ebullient cooling systems. Its properties offer freeze protection, ideal operating temperatures, and extreme corrosion resistance.

For more information on Ambitrol, Dowtherm 209, or any petroleum industry problem involving chemicals, write directly to THE DOW CHEMICAL COMPANY at Midland, Michigan. *TRADEMARK

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

The right Macwhyte

reduces wire-line wear



INDUSTRIAL ★ AIRCRAFT ★ MINING ★ LOGGING ★ ELEVATOR ★ MARINE ★ CONSTRUCTION ★ DRILLING
MACWHYTE
THE RIGHT MACWHYTE
WIRE ROPE
MADE IN U.S.A.

ROTARY TON-MILE CALCULATOR AVAILABLE FREE—Round trip ton-mile calculator with double slides is of special interest to contractors, drilling superintendents and engineers. Ask any Macwhyte office or distributor for Calculator No. 58101.

Less wire-line wear means less maintenance and replacement

In the right Macwhyte, you get the exact combination of the wearing qualities your equipment demands. Macwhyte has more than 60 years' experience in meeting the needs of the oil patch in...

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Pumping Lines	Core Barrel Lines	Sucker Rod Lines
Swabbing Lines	Torpedo Lines	Stainless Steel Lines
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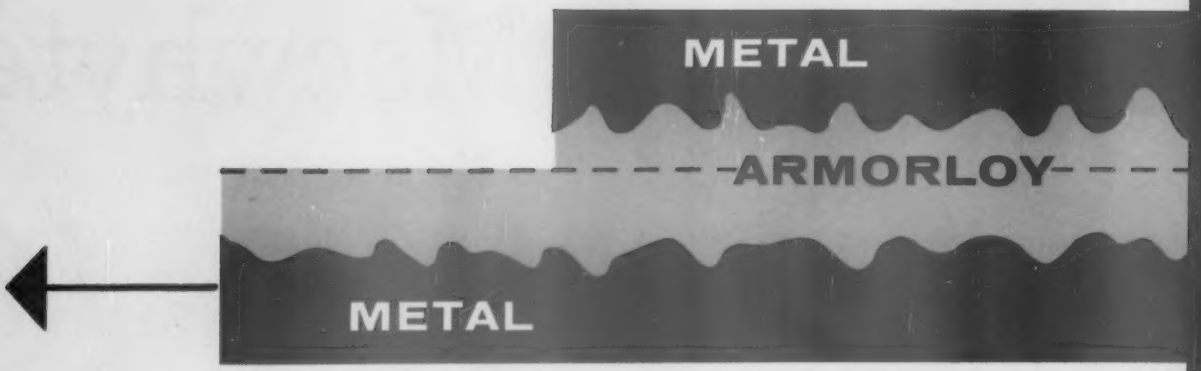
Ask about Macwhyte's new 7-FLEX® wire rope

MACWHYTE Wire Rope COMPANY

Wire Rope Manufacturing Specialists Since 1896



NEW A. O. SMITH ARMORLOY CAPACITY TO PETROLEUM METERS

New solid film lubricant features exceptional corrosion resistance qualities

ARMORLOY — a new, unique lubricating film application is now standard on A. O. Smith petroleum meters. Armorloy is the same type of solid film lubricant which has been used with great success on jet and rocket engine applications.

Tough as nails, the new A. O. Smith Armorloy process is especially valuable in fighting the normal corrosive action of some metered fluids. Armorloy also provides maximum protection against wear and friction for contact components because it greatly increases the self-lubricating ability of the meter.

You can't take it off without removing the basic metal — Armorloy is sprayed onto the metal surface of all internal metal components, then baked at 300 F for one-half hour. After this scientifically controlled thermosetting, Armorloy is on to stay.

Thanks to the introduction of Armorloy — plus important additional changes — A. O. Smith is also proud to announce the *new capacity ratings* for its complete line of line and high pressure meters.

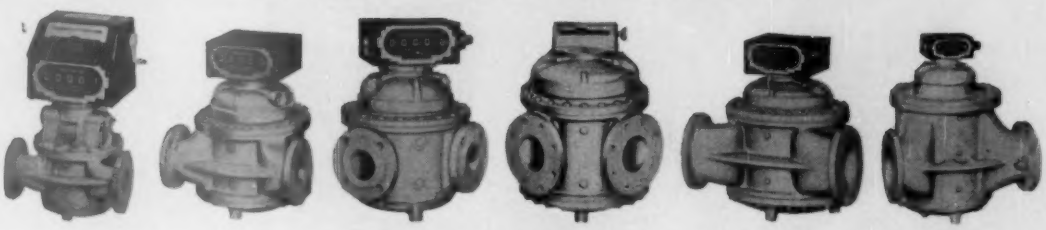
Armorloy is just another step in A. O. Smith's far-reaching design program to make petroleum meters serve your industry better!

SEND FOR ARMORLOY SAMPLES! Rub them together, feel — and test — Armorloy's outstanding lubricated surface. Simply fill out the coupon and mail.

PROCESS ADDS LIFE AND EXTRA AT NO EXTRA COST TO YOU!

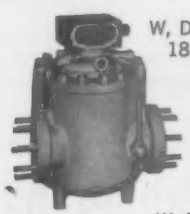
New Armorloy process helps increase meter capacity as much as 25%

LINE METERS



S & B-13 130 GPM | S-28 280 GPM | S, AS & AB-42 420 GPM | S, AS & AB-60 600 GPM | S & AB-100 1000 GPM | B-170 1700 GPM

HIGH PRESSURE METERS



W, D & M-13 185 BPH

W, D & M-28 400 BPH

W, D & M-42 600 BPH

W, D & M-60 860 BPH

W, D & M-90 1285 BPH

W-170 2430 BPH

B & W-250 3570 BPH

B & W-875 12500 BPH

Through research ... a better way

A.O.Smith
CORPORATION
METER & SERVICE STATION EQUIPMENT DIVISION

Factory: 1602 Wagner Ave., Erie, Pennsylvania. Offices: Atlanta 24, Ga.; Chicago 3, Ill.; Houston 2, Tex.; Los Angeles 22, Calif.; New York 17, N.Y.; Newark, Calif.; Tulsa, Okla. — A. O. Smith INTERNATIONAL, S. A., Milwaukee 1, Wis., U.S.A.

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Name ..... Title .....
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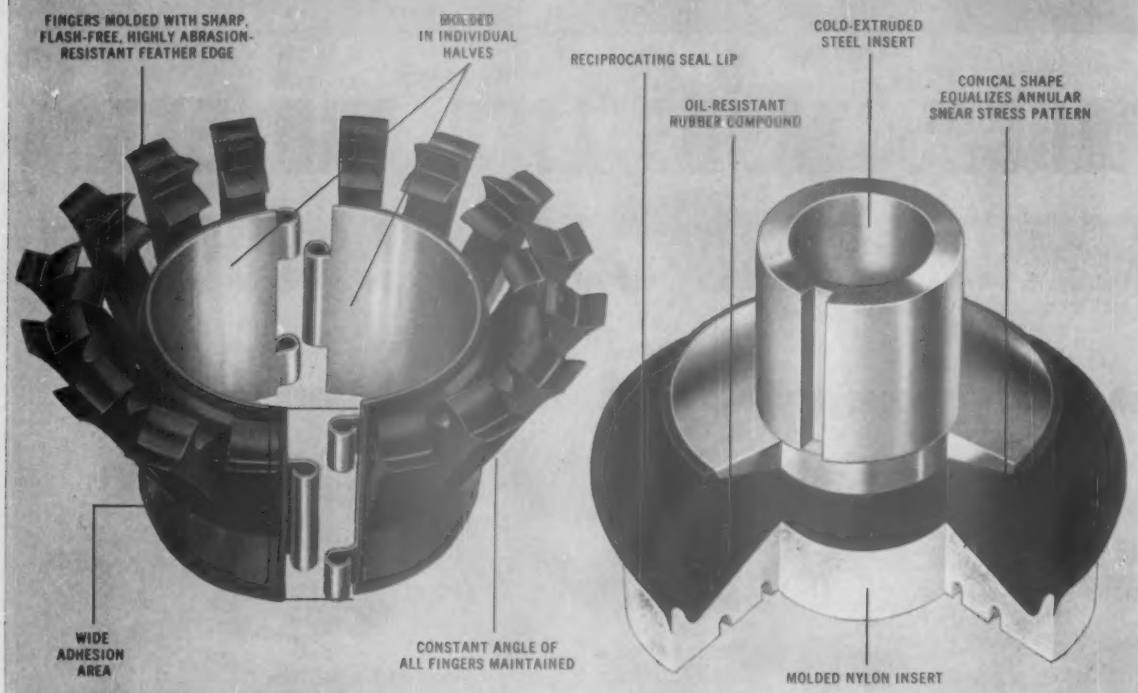
City ..... Zone ..... State .....

OHIO RUBBER

"CUSTOMEERED COMPONENTS BASIC TO INDUSTRY"


FINGERS MOLDED WITH SHARP, FLASH-FREE, HIGHLY ABRASION-RESISTANT FEATHER EDGE
MOLDED IN INDIVIDUAL HALVES
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COLD-EXTRUDED STEEL INSERT
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WIDE ADHESION AREA
CONSTANT ANGLE OF ALL FINGERS MAINTAINED
MOLDED NYLON INSERT

"RECIPO" OIL WELL WALL CLEANER—removes filter cake, mud, and foreign objects from bore hole. **Problem Solved:** Compression mold and bond-to-metal very flexible, high tensile, top quality natural rubber stock to extremely critical customer specifications. Design, build, operate, and maintain highly intricate molds to operate on normal production basis. Safeguard part against tremendous high stress concentration by engineering permanent, rubber-metal adhesion.

FLEXIBLE COUPLING—"customeered" to a specific rate of torsional shear. **Problem Solved:** Bonding of tough rubber compound to greatly dissimilar materials—steel and nylon. Reliable manufacture in bulk by OHIO RUBBER called for special handling of materials, rigid temperature control, building and maintenance of custom-designed compression molds.

"Direct from factory" service on rubber parts!

OHIO RUBBER IS YOUR GOOD SOURCE for quality oil field parts precision-made from rubber or rubber-like materials. And, the rubber industry's newest, most modern plant (190,000 square feet) at Fort Smith, Arkansas is ready to serve you "direct from factory"—to offer full research and development facilities, experienced rubber engineering, cost-cutting production methods and the best in technical field service. We'd be glad to hear from you—call us today!

Factories: Long Beach, Calif. • Fort Smith, Ark. • Willoughby, O. • Conneautville, Penn. • Stratford, Conn.

ORCO

THE OHIO RUBBER COMPANY

General Office • WILLOUGHBY, OHIO • WHitehall 2-0500

A DIVISION OF THE EAGLE-PICHER COMPANY

EAGLE EP PICHER

FREE!

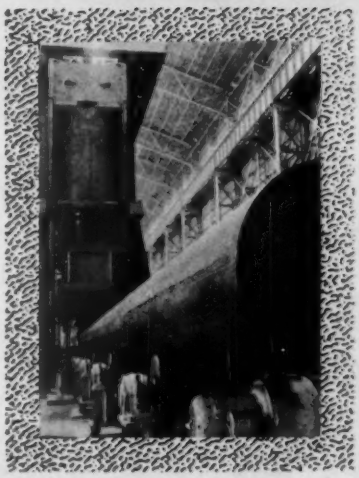
RUBBER DESIGN DATA

These comprehensive, factual manuals should be in your working library. Ask for Form 730 and "Orthane" bulletin.

PE-61

NKK MEANS REALLY SUPERIOR LINE PIPE

The highest quality line pipe is a major product of our completely integrated production line. Our High-Pressure Line Pipe is produced in accordance with API standard 5LX at NKK's new Large Diameter Welded Pipe Mills — the only installation of its kind in the Orient. It is a superb product of the U.O.E. Process. This high-yield strength pipe is made by the Automatic Submerged Arc-Welding and Hydraulic Cold-Expanding System . . . For a really superior line pipe you're invited to take advantage of NKK's 50 years of experience as Japan's leading steel maker. Write for details & catalogs.



NKK

NIPPON KOKAN K.K.

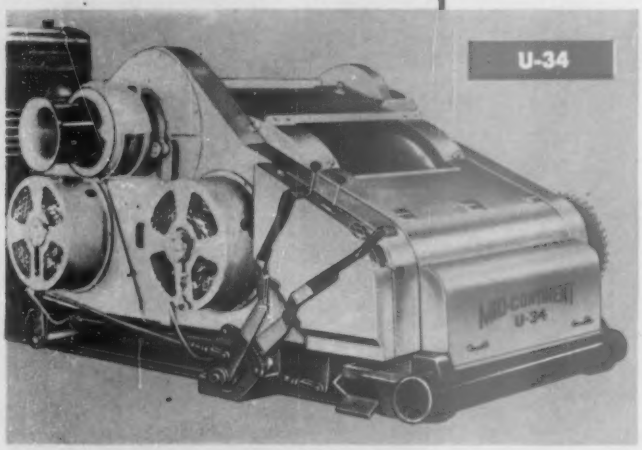
(Japan Steel & Tube Corporation)

HEAD OFFICE: Otemachi, Chiyoda-ku, Tokyo, Japan
NEW YORK OFFICE: Rm. 1115, 39 Broadway, New York 6, N.Y., U.S.A.
EUROPEAN OFFICE: Kreuzstrasse 34 II, Düsseldorf, West Germany
SINGAPORE OFFICE: Rm. 414, Shaw House, Orchard Road, Singapore

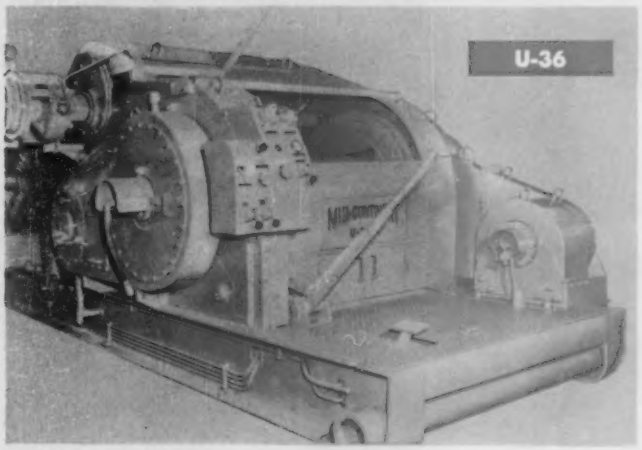
Mid-Continent Drawworks..

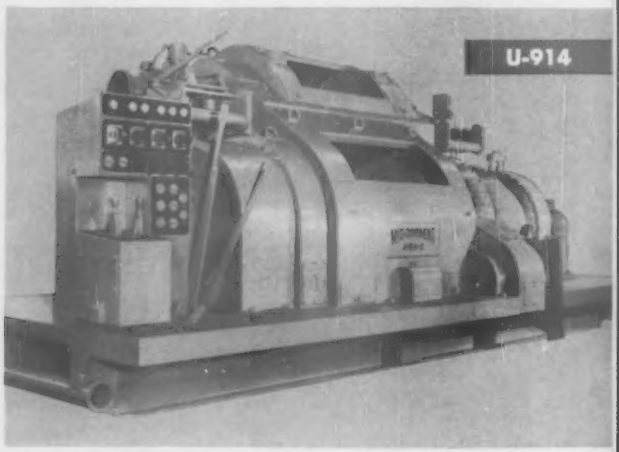
V-P-S*

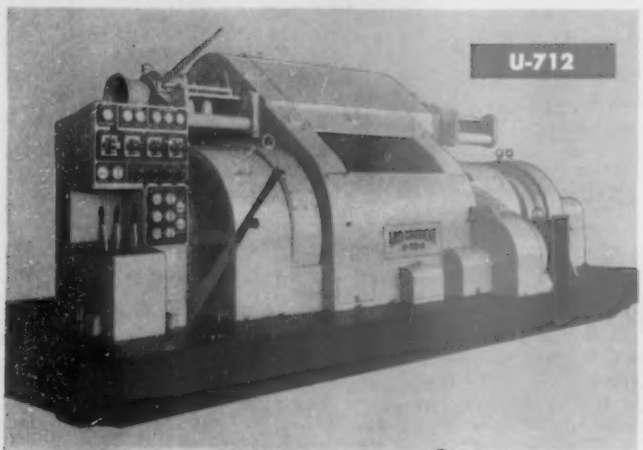
RANGE OF 140 TO 200

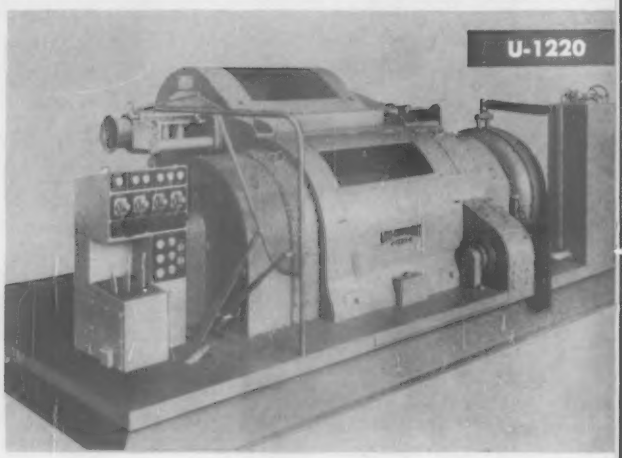


Mid-Continent Drawworks have been proven and accepted in oilfields throughout the world. Large drums, short bearing centers, heavy chains, grease lubrication, accessible drum clutches, and engineered portability are outstanding features. Five basic models, with either single or double drums, are available. Appropriate drives include straight mechanical . . . torque converter . . . fluid coupling . . . or electric. For assistance in selecting a Mid-Continent drawworks to meet your requirements, call your nearest Mid-Continent representative.









*VALUE-PLUS-SERVICE

RUGGED-SIMPLE-DEPENDABLE

INPUT HORSEPOWER CAPACITY

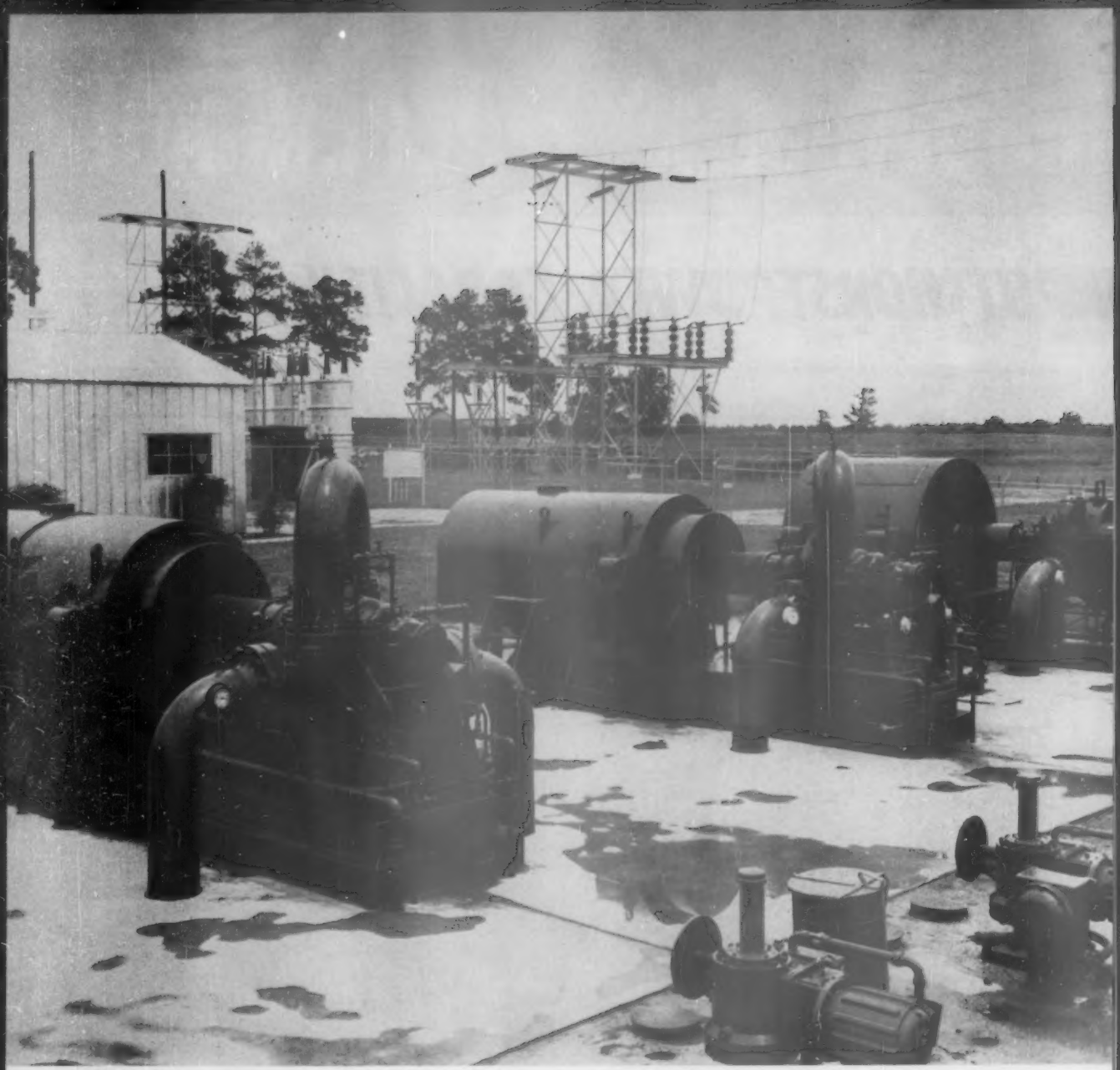
SPECIFICATIONS	U-34	U-36	U-712	U-914	U-1220
Horsepower	140-300	300-600	700-1200	900-1400	1200-2000
Drum	12¾" x 37"	18" x 46"	25" x 51½"	29" x 53¼"	32¼" x 57"
Drum Brakes	7" x 38"	10" x 44"	10" x 48"	10" x 52"	10" x 60"
Speed:					
Hoisting	2—Forward	2—Forward	6—Forward 2—Rev.	6—Forward 2—Rev.	6—Forward 2—Rev.
Rotary	1—Forward R—Optional	1—Forward	3—Forward 1—Rev.	3—Forward 1—Rev.	3—Forward 1—Rev.
Single Line (FPM)	2000'	3300'	3338'	3576'	3990'
Single Line Pull (Max.)	49,000#	50,000#	75,302#	75,600#	96,900#
Chain:					
Input	1¼"—Double	1¼"—Quad.	1½"—Quad.	1½"—Quad.	1½"—Sext.
Low Drum	1¾"—Single	1½"—Triple	1¾"—Triple	1¾"—Quad.	2½"—Triple
High Drum	1¾"—Single	1½"—Double	1¾"—Triple	1¾"—Quad.	2½"—Triple
Rotary C.S.	1¾"—Single	1½"—Single	1¾"—Double	1¾"—Double	2½"—Single
Clutches:					
Low Drum	3 Pl. 20" Air-O-Matic	24VC650 Fawick	38VC1200 Fawick	38VC1200 Fawick	42VC1200 Fawick
High Drum	2 Pl. 20" Air-O-Matic	24VC650 Fawick	32VC1000 Fawick	38VC1200 Fawick	42VC1200 Fawick
Rotary	2 Pl. 14" Air-O-Matic	14CB400 Fawick	20VC600 Fawick	20VC600 Fawick	20VC600 Fawick
Bearing Lubrication	Grease	Grease	Grease	Grease	Grease
Auxiliary Brakes:					
Hydromatic	15" Single or Double Hydromatic	15" or 22" Double Hydromatic	40" or 46" Single Hydromatic	46" or 60" Hydromatic	60" Hydromatic
Electric	———	———	Optional	Optional	Optional
Sandreel: Capacity 9/16" Line	11,127'	12,200'	14,660'	14,660'	20,300'
Transport:					
Length	15'-4"	24'-0"	24'-0"	24'-0"	24'-0"
Width	7'-11¾"	9'-6"	9'-10"	10'-0"	8' & 6'-3"
Height	5'-8"	7'-2"	8'-7½"	8'-10¾"	7'-8" & 8'-7"
Weight	12,950# Single Package	28,200# Single Package	40,750# Single Package	45,575# Single Package	38,080# & 27,300# 2 Sections

DW1-1

MID-CONTINENT SUPPLY CO.

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

Mid-Continent Building, Fort Worth, Texas • Export Division: 45 Rockefeller Plaza, New York 20, N.Y. Cable: MIDCUMPORT NYK



Electric pumping station pushes its own buttons

Lowest possible cost of utility electric power is obtained by programming units on or off . . . according to quantity of oil to be pumped.

Need for automatic batching and increased capacity called for retiring engines and modernization of this station with three 600 hp and one 1,500 hp electric motors . . . plus the usual push button station sequence and protective systems. This is another example of the adaptability of dependable, economical utility electric power. Consult your local Utility Electric Power Company for possible savings in your operation.

Petroleum Electric Power Association

P. O. Box 35006 • Dallas 35, Texas

List of P. E. P. A. members will be furnished on request.

Every string of Armco Casing cuts costs

2 IMPORTANT WAYS

Here's how Armco Casing, distributed by National Tank Company from 26 stocking points throughout the oil country, can save you money:

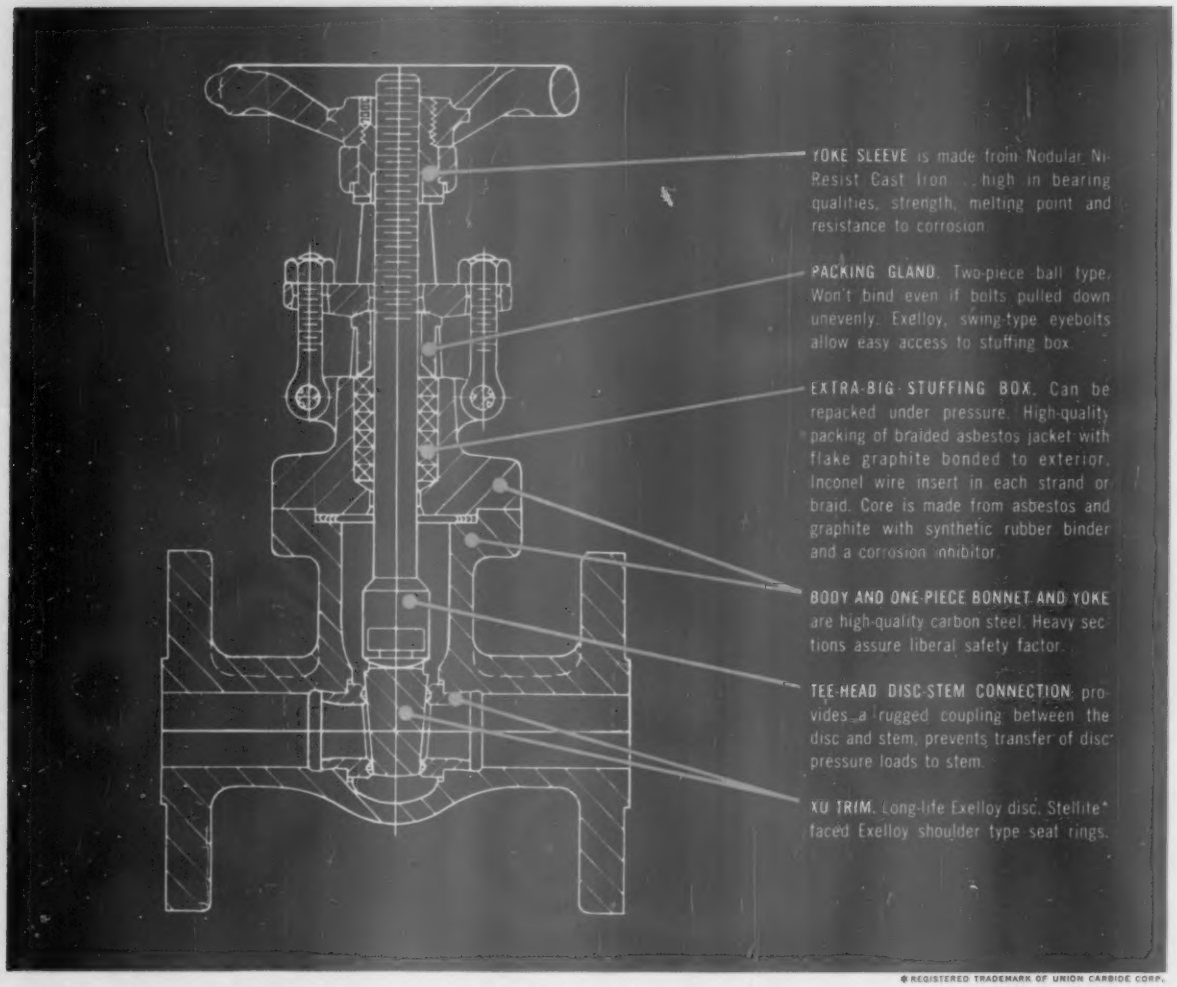
Low Original Cost. Armco Casing generally costs less than threaded casing. And because the high collapse resistance of Armco Casing is uniform throughout, you can safely set lighter, lower cost strings to greater depths.

Fast Running Time. Welding costs are low with Armco Casing because they can be welded quickly. Stab one end of a joint into the Armco Slip-Joint Collar, make a fast downhand fillet weld and lower away.

For strength, economy, durability

Armco Casing sizes range from 6 to 24 inches. For information, write **Armco Drainage & Metal Products, Inc., subsidiary of Armco Steel Corporation, 8081 Curtis Street, Middletown, Ohio, or 202 KOME Building, Tulsa, Oklahoma.**

ARMCO Drainage & Metal Products


YOKE SLEEVE is made from Nodular Ni-Resist Cast Iron . . . high in bearing qualities, strength, melting point and resistance to corrosion.
PACKING GLAND. Two-piece ball type. Won't bind even if bolts pulled down unevenly. Exelloy, swing-type eyebolts allow easy access to stuffing box.
EXTRA-BIG STUFFING BOX. Can be repacked under pressure. High-quality packing of braided asbestos jacket with flake graphite bonded to exterior. Inconel wire insert in each strand or braid. Core is made from asbestos and graphite with synthetic rubber binder and a corrosion inhibitor.
BODY AND ONE-PIECE BONNET AND YOKE are high-quality carbon steel. Heavy sections assure liberal safety factor.
TEE-HEAD DISC-STEM CONNECTION provides a rugged coupling between the disc and stem, prevents transfer of disc pressure loads to stem.
XU TRIM. Long-life Exelloy disc. Stellite* faced Exelloy shoulder type seat rings.

*REGISTERED TRADEMARK OF UNION CARBIDE CORP.

Crane adds flanged 150 & 300-pound steel gate valves to famous 3600 series.

Gives you a complete line of Small Steel Gate Valves suitable for all services at temperatures up to 1000 F. Available in sizes ½" to 2". Gives you design refinements generally associated only with higher priced valves.

The drawing illustrates only a few of the important features of these superior valves. There is built-in quality and reliability in every detail. Outside screw and yoke ruggedly constructed. Stem is heat treated Crane Exelloy. Bonnet joint gasket of spiral wound, Type 316 stainless steel with asbestos filler.

The cast steel 150 & 300-pound valves have "XU" trim and flanged ends (face-to-face conforms to ASA B — 16. 10) . . . figure numbers 3510XU (150 pound) and 3514XU (300 pound).

With the addition of these new valves to the 3600 Series, Crane now offers you the industry's finest choice of quality, small steel valves. All of them are ideally suited for use with steam, water, air, gas, oil, oil vapor, gasoline, fuel oil and similar services.

More details from your Crane distributor. Or write to Crane Co., Dept. G, Industrial Products Group, 4100 South Kedzie Ave., Chicago 32, Ill. In Canada: Crane Ltd., 1170 Beaver Hall Square, Montreal.

AT THE HEART OF HOME AND INDUSTRY

CRANE

VALVES AND PIPING
ELECTRONIC CONTROLS
PLUMBING
HEATING • AIR CONDITIONING

THE SURPRISING ECONOMICS OF BONDSTRAND®

...the pipe designed for corrosive chemicals

A 20′ length of 6″ schedule 40 carbon steel pipe weighs 398 lbs. Crane required for lifting.

A 20′ length of 6″ Bondstrand pipe weighs only 60 pounds. One man can lift and carry.

Cutting steel pipe takes four (or more) times longer than Bondstrand.

Bondstrand is cut with ordinary hacksaw. Preheating not required.

Two men required to bevel, clean, position, center and level a 90° elbow before welding.

Only one man required to apply adhesive and position a 90° Bondstrand elbow. It aligns itself.

Welder and helper required to tack weld, check alignment, make stringer weld and grind, make flush weld and grind again, make cover weld, grind and wire brush.

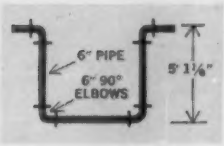
One man with a hammer and a two-by-four makes the Bondstrand Quick-Lock joint in a matter of seconds. Important: **Bondstrand pipe may be handled immediately; no waiting for adhesive to cure.**

IT TOOK 65 MINUTES TO WELD ONE ELBOW TO STEEL PIPE. ONE MAN MADE THE SAME ASSEMBLY WITH BONDSTRAND IN ONLY 10 MINUTES!

BONDSTRAND, the fiber glass reinforced epoxy pipe, handles nearly every corrosive solution—acids, salts, alkalies—used in industry today. It will withstand pressures up to 550 psi and temperatures up to 300°F. So will the complete line of BONDSTRAND fittings, 2″ through 12″.

The smooth, abrasion-resistant inner surface permanently retains its excellent flow characteristics (Hazen-Williams formula C=150) and thus often permits use of one-size-smaller diameter pipe. BONDSTRAND is only one-eighth the weight of steel and because it resists exterior as well as interior corrosion it does not require continual maintenance painting.

BONDSTRAND versatility is unmatched by any other pipe—metallic, thermoplastic, glass or lined. What does this superiority cost? Less than you may suspect. Here is how BONDSTRAND compares with carbon steel in this simple pipe layout:



TOTAL COST OF MATERIAL AND LABOR

Schedule 40 **Carbon Steel** Pipe With Welding Elbows **$225.63**

Series 4000 **Bondstrand** Pipe With Bondstrand Elbows **$287.40**

Figures shown are from a strict time-and-cost study conducted by one of Southern California's leading independent piping and engineering firms.

This means that in this layout you get all the advantages of BONDSTRAND for only 21.7% more than ordinary carbon steel pipe. (In complex process piping, BONDSTRAND can actually cost less.) In Schedule 40 stainless steel, which approximates BONDSTRAND's chemical resistance, the layout would cost $1,287.50—*348% more than* BONDSTRAND!

To evaluate the superiority of BONDSTRAND *pipe for your specific requirements, write for complete technical data.*

Amercoat® CORPORATION

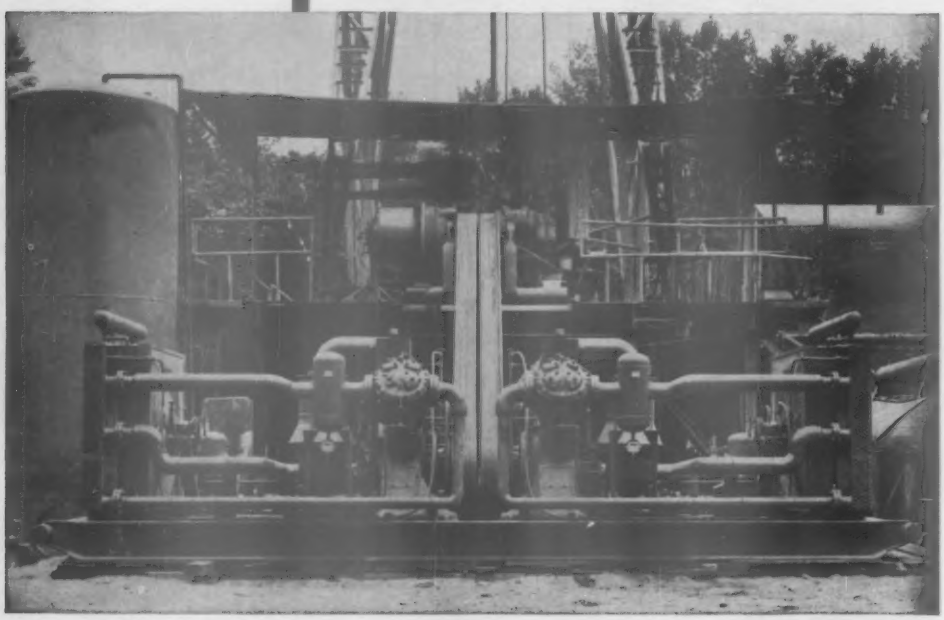
Dept. CU, 4809 Firestone Blvd., South Gate, California

921 Pitner Ave. Evanston, Ill.
360 Carnegie Ave. Kenilworth, N. J.
111 Colgate Ave. Buffalo, N. Y.
2404 Dennis St. Jacksonville, Fla.
6530 Supply Row Houston, Tex.

DRILL

AND MOVE

AND DRILL AGAIN

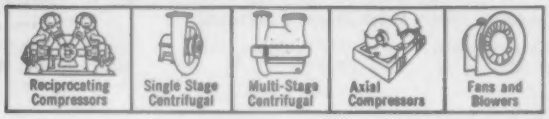


JOY AIR DRILLING COMPRESSORS ARE COMPLETELY SELF CONTAINED

Joy packaged compressors are ready to run when they arrive at the job. The compressor, power unit, heat exchangers, piping and controls are mounted on a single skid. They can be operated on the ground without any foundation, or left on the trailer for frequent short moves.

Power units may be diesel or natural gas. Compressors are available with multiple V-belt drive from the drilling rig, like the unit shown here. There are many types and sizes of Joy packaged compressors for air drilling with capacities up to 300 psi; 400 hp. For complete information on the proper model for your operations, write for bulletin 2823-31.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

MATHIESON
Sulfuric Acid

H_2SO_4

ECONOMIC ANALYSIS

Reliable cost figures depend on many factors relating to your individual location and requirements. Part of Mathieson's responsibility is the development of realistic figures for you in this area.

DEPENDABLE SUPPLY

Strategic locations assure you fast delivery of all commercial grades of sulfuric acid from our plants and shipping points in Beaumont, Port Arthur, Pasadena, Texas... Little Rock, Ark.... Bossier City, La.... Baltimore, Md.

ACID RECOVERY

Dependable outlets for spent acid can be as important as acid supply. Olin Mathieson's long experience in spent acid handling determines our recommendations for the most advantageous disposal of your spent material.

SAFETY

New operations, new employees... you will need complete safety and handling instructions. We supply these in both literature and wall chart form.

TECHNICAL ASSISTANCE

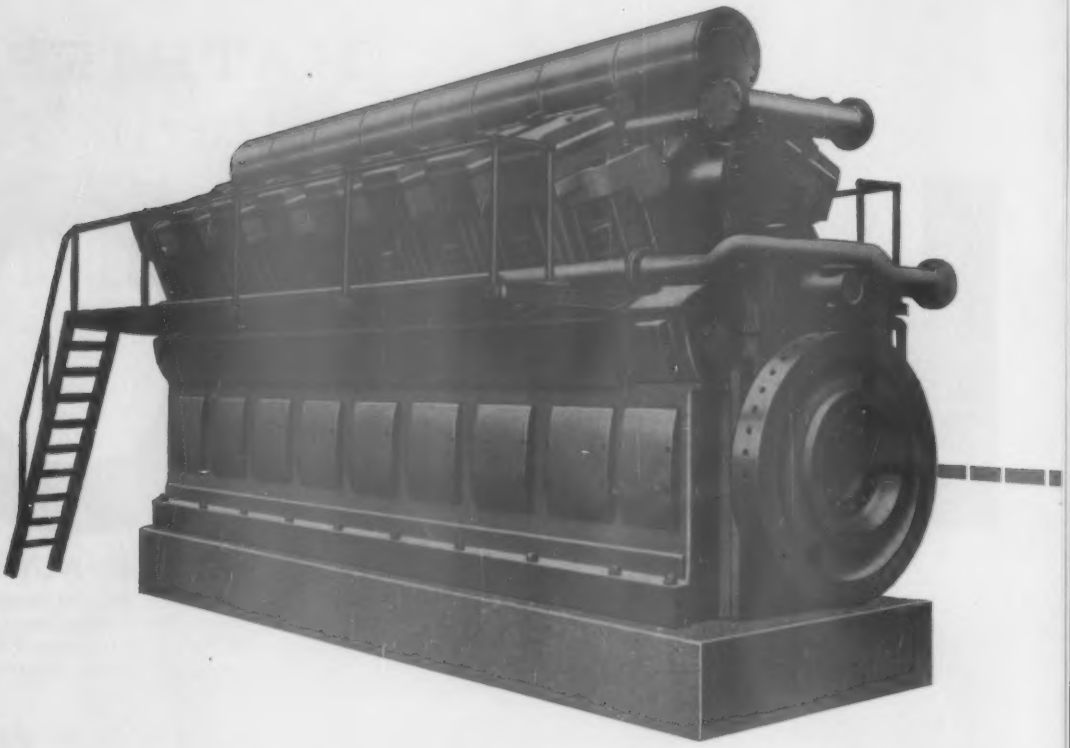
Your Olin Mathieson man knows the petroleum field and the chemical industry. His on-the-spot knowledge and our laboratory facilities and experience are at your disposal. For product specifications or service, call or write: OLIN MATHIESON, Balto., 3, Md.

Ammonia • Carbon Dioxide • Caustic Soda • Chlorine • Hydrazine and Derivatives • Hypochlorite Products • Methanol • Muriatic Acid • Nitric Acid • Soda Ash • Sodium Bicarbonate • Sodium Chlorate • Sodium Chlorite Products • Sodium Methylate • Sodium Nitrate • Sulfur (Processed) • Sulfuric Acid • Urea

Olin

CHEMICALS DIVISION

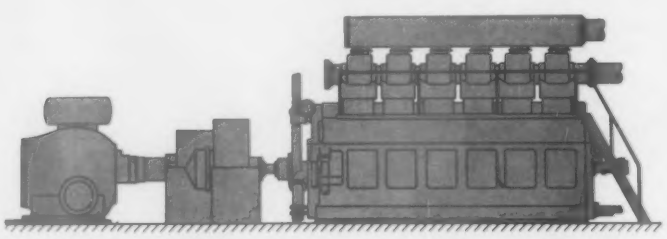
8956



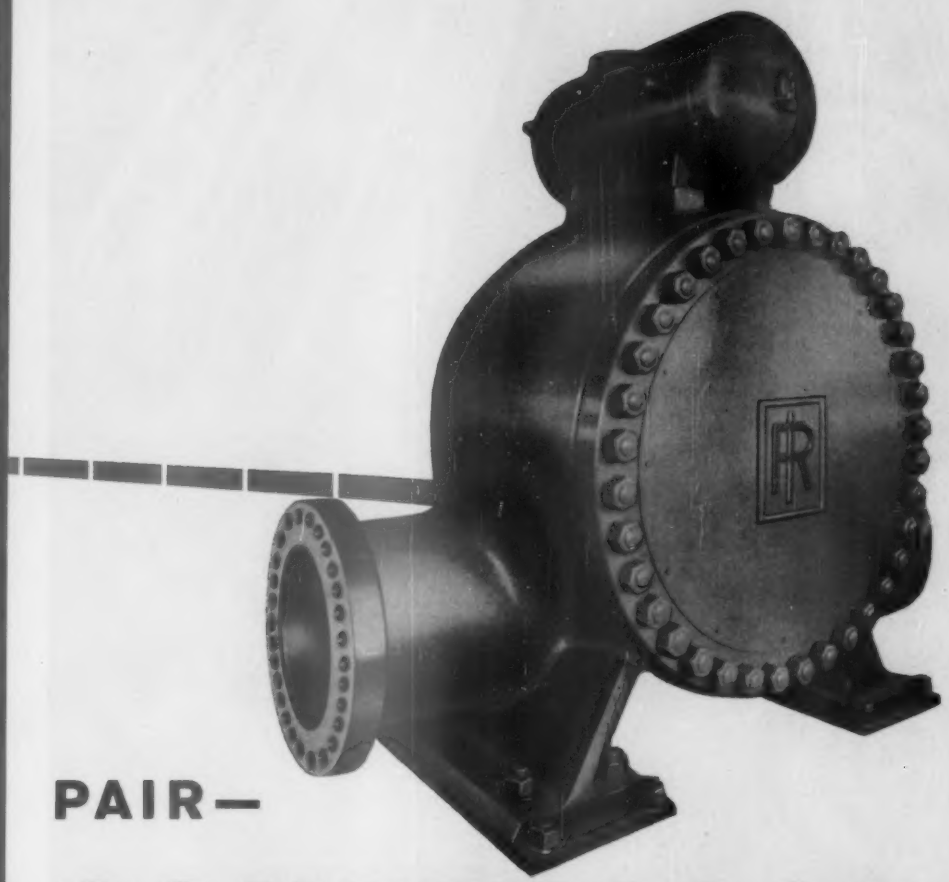
A NEW MATCHED PIPELINE

POWER....and

The completely-new Ingersoll-Rand PKVT gas engine is the ideal prime mover for a centrifugal pipeline compressor — right in size, right in power and right for highest economy. Using a high-level constant-pressure turbocharging system, this engine will run continuously at full load with a fuel input of only 6300 btu/bhp/hr. Its rugged design and conservative rating permit years of full-load operation with minimum attention, with generous capacity for emergency overloading. Like other Ingersoll-Rand 4-cycle V-angle gas and diesel engines, the PKVT operates smoothly under any load and at widely-varying speeds without "hunting" or skipping.



Perfectly matched for top performance and economy, the PKVT gas engine and the CDP centrifugal compressor make a pace-setting pair for dependable, low-cost pipeline compression.



PAIR—

COMPRESSOR

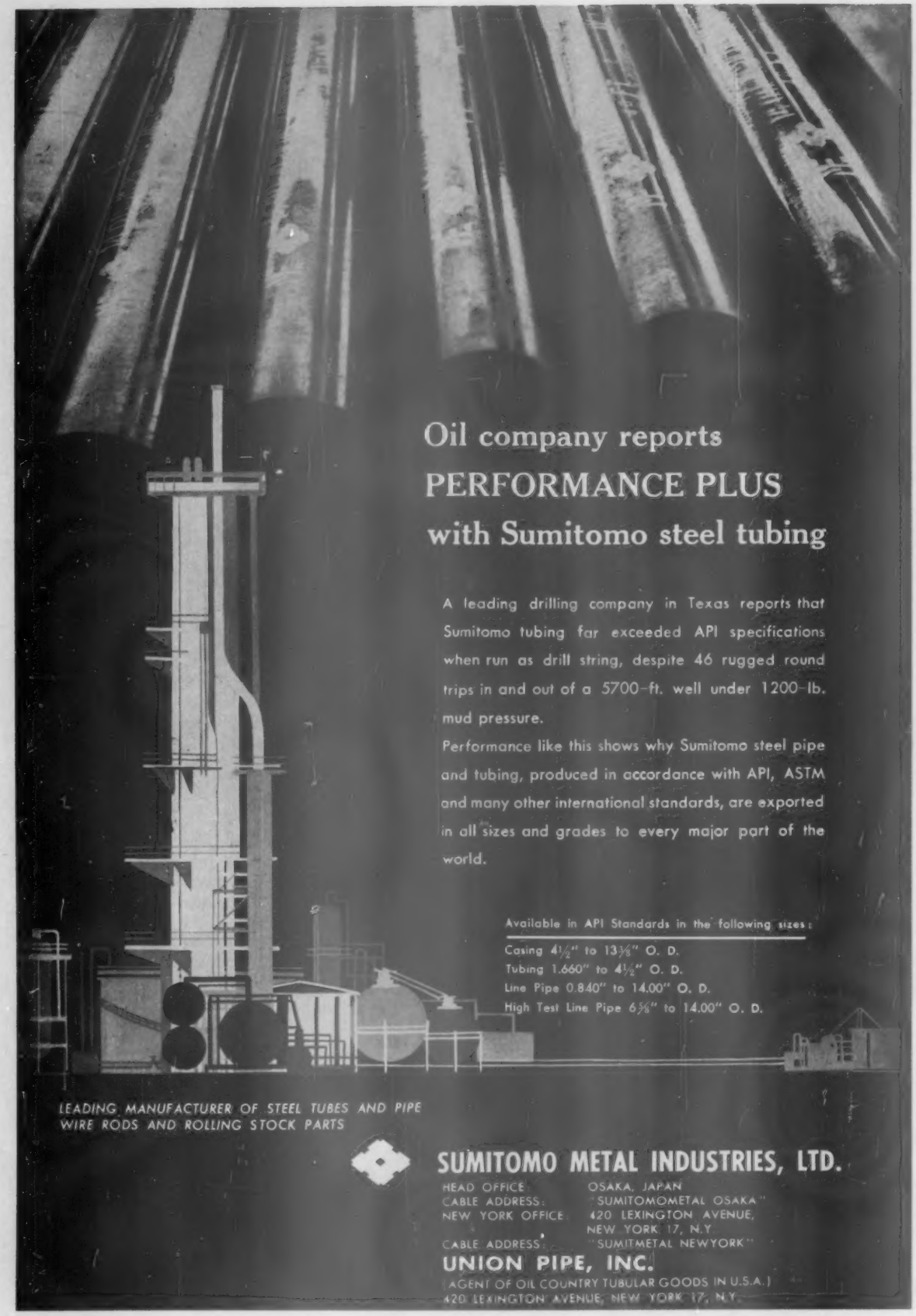
The Ingersoll-Rand CDP centrifugal compressor is a heavy-duty single-stage unit designed especially for pipeline service. Its advanced features include semisphere casing with low-line connections for maximum strength; an inlet trumpet which provides axial-inlet efficiency with in-line piping connections; and unitized plug assembly. Positive shaft sealing is provided by floating-ring clearance-type seals, which were pioneered and perfected by Ingersoll-Rand. The design of internal elements permits complete convertibility to meet changing system requirements quickly and easily.

Ingersoll-Rand

Ad 262-A-14

11 Broadway, New York 4, N.Y.

THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE



Oil company reports PERFORMANCE PLUS with Sumitomo steel tubing

A leading drilling company in Texas reports that Sumitomo tubing far exceeded API specifications when run as drill string, despite 46 rugged round trips in and out of a 5700-ft. well under 1200-lb. mud pressure.

Performance like this shows why Sumitomo steel pipe and tubing, produced in accordance with API, ASTM and many other international standards, are exported in all sizes and grades to every major part of the world.

Available in API Standards in the following sizes:

Casing 4½" to 13⅜" O. D.
Tubing 1.660" to 4½" O. D.
Line Pipe 0.840" to 14.00" O. D.
High Test Line Pipe 6⅝" to 14.00" O. D.

LEADING MANUFACTURER OF STEEL TUBES AND PIPE WIRE RODS AND ROLLING STOCK PARTS

SUMITOMO METAL INDUSTRIES, LTD.

HEAD OFFICE: OSAKA, JAPAN
CABLE ADDRESS: "SUMITOMOMETAL OSAKA"
NEW YORK OFFICE: 420 LEXINGTON AVENUE, NEW YORK 17, N.Y.
CABLE ADDRESS: "SUMITMETAL NEWYORK"

UNION PIPE, INC.
(AGENT OF OIL COUNTRY TUBULAR GOODS IN U.S.A.)
420 LEXINGTON AVENUE, NEW YORK 17, N.Y.

Bitumastic® No. 50 protects tank for corrosive, swamp-land service

The problem of protection for metal tanks in soils with high moisture content has long been a matter of concern to corrosion specialists: the protective coatings chosen must provide years of maintenance-free service and absolute resistance to corrosive attack by sub-soil moisture. Inspection and repair of buried tanks can be prohibitively expensive.

That's why five petroleum storage tanks, identical to that pictured above, were recently installed at a service station in Secaucus, New Jersey, after a costly failure of older tanks. Bitumastic No. 50 was chosen for heavy-duty protection of these tanks from sub-soil moisture in the loamy Jersey Meadow.

The surface of each tank unit was thoroughly cleaned, and then given a permanent covering of Bitumastic No. 50, the Koppers coating with tough, thick, water-resistant qualities for heavy-duty service.

The unique protective qualities of Koppers coal-tar coatings serve corrosion experts in almost every industrial and marine application. Bitumastic coatings have become synonymous with the finest form of corrosion protection available today. For information on the Bitumastic coating suited to your needs, send the coupon or write: Koppers Company, Inc., Pittsburgh 19, Penna. District Offices: Chicago, Los Angeles, Pittsburgh, New York and Woodward, Ala. In Canada: Koppers Products, Ltd., Toronto, Ontario.

KOPPERS

KOPPERS

BITUMASTIC

COATINGS AND ENAMELS

another fine product of COAL TAR

KOPPERS COMPANY, INC.
Tar Products Division
Dept. 104J
Pittsburgh 19, Pa.

Gentlemen:
Please send me more information on the Bitumastic family of protective coatings.

Name_____

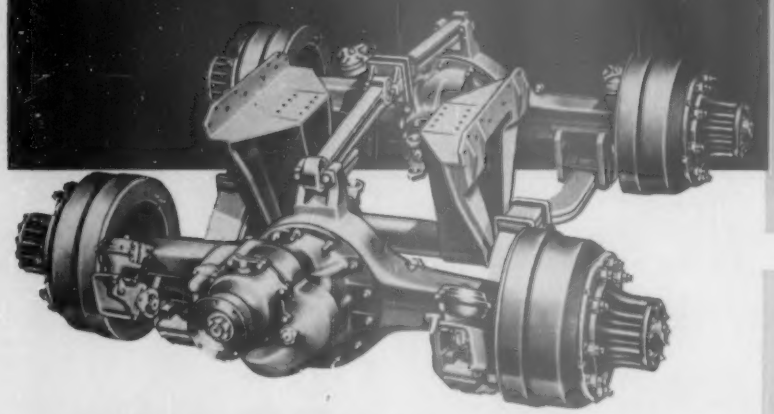
Firm_____ Title_____

Address_____

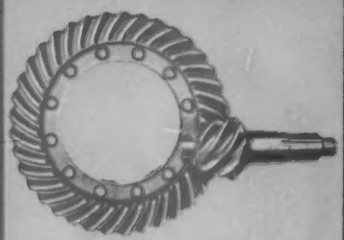
City_____ Zone____ State_____

MORE THAN 200 MILLION EXTRA TON-MILES OF PAYLOAD IN JUST 5 YEARS

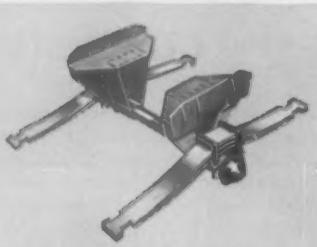
WITH ROCKWELL-STANDARD LIGHTWEIGHT TANDEMS



Driver Controlled Inter-axle Differential. Allows differential action between the axles to compensate for worn or mismatched tires . . . both axles do equal amounts of work. Can be dis-engaged at any speed giving positive thru-drive when better traction is needed.



Stronger Gear Sets. Hypoid gearing provides up to 30% more strength than spiral bevel gears of the same size. Modern hypoid design allows larger and stronger pinions with greater tooth contact area . . . assuring top efficiency and long life.



New Suspension Pushes Tandem Weight Savings Over 1000 Lbs. Rockwell-Standard's "taper-leaf" springs coupled with the latest in balanced suspension system designs is up to 434 lbs. lighter than comparable units. When combined with the payload advantages of the Lightweight Tandem you can save more than 1000 pounds per trip. This means thousands of ton-miles in extra payload per year.

In the five years since Rockwell-Standard introduced their Lightweight Tandems, thousands of users have rolled up millions of extra ton miles of payload. Check the superior features illustrated at right. They are some of the reasons why these axles are first choice with over-highway operators:

Plus these additional Rockwell-Standard advantages:

- In-line drive reduces wear on working parts
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- Large selection of gear ratios
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- Wide range of capacities – 8 models from 22,000 to 44,000 pounds

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Send for Bulletin #1-60 which illustrates and describes LimiTorque Valve Operators . . . Please use your Business Letter-head when requesting a copy.

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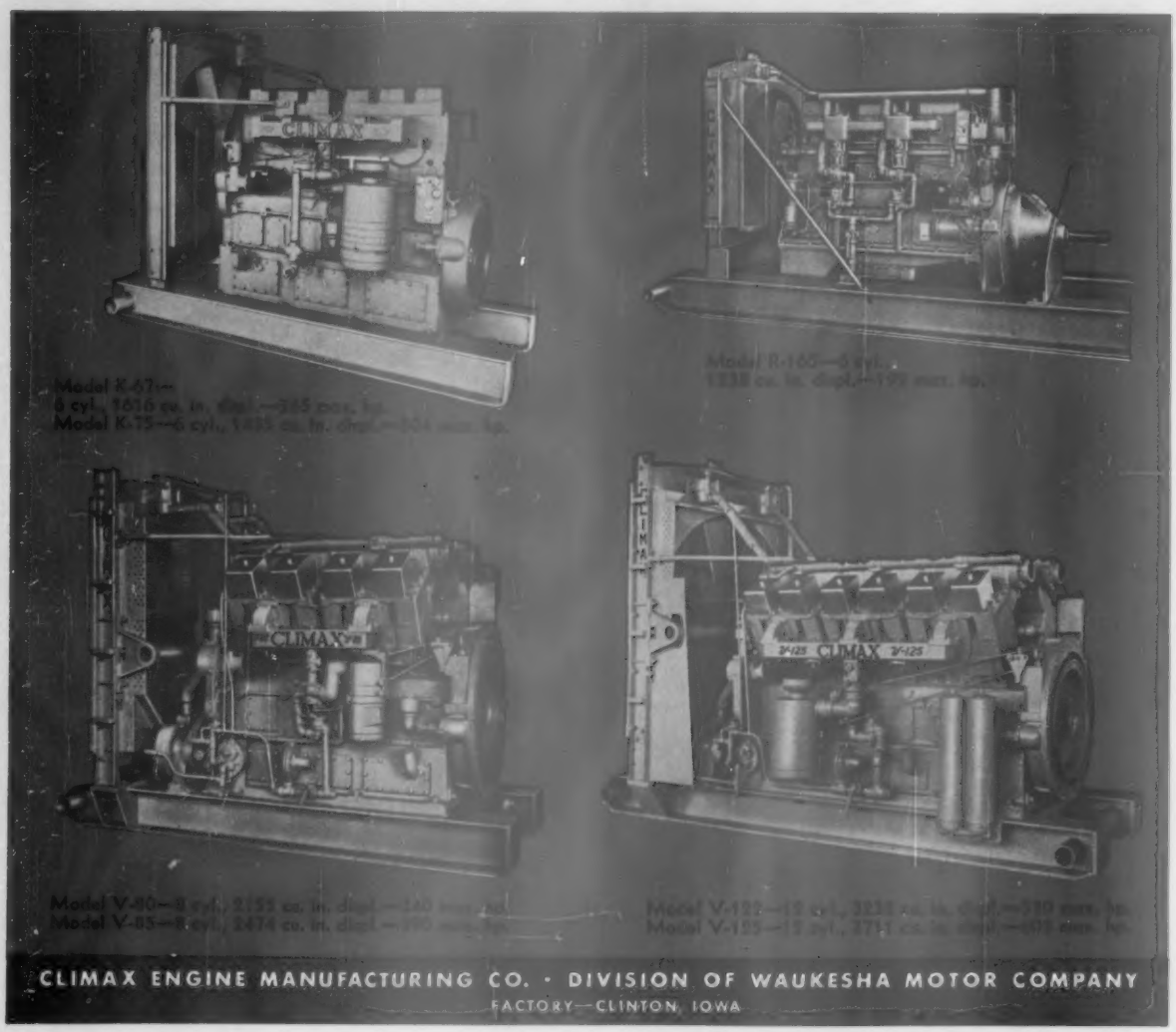

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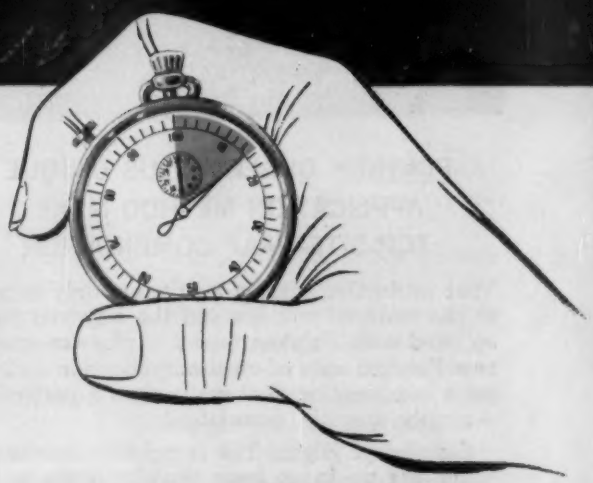

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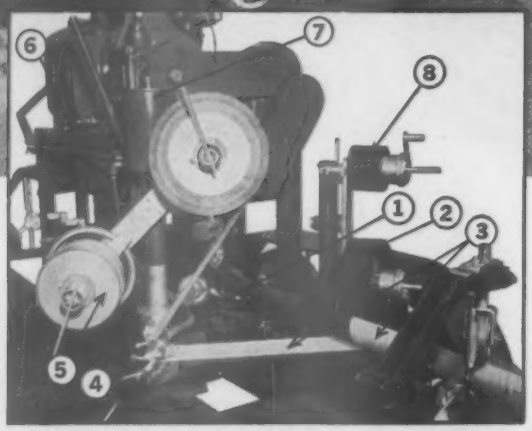

Pipe (coming toward you) spins through machine . . . undergoes dynamic cleaning from twin-powered brush heads. Coating comes off brake-type tape drum. Outer wrapping runs through fast-gluing adhesive attachment.

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2. Polyken tape coating
3. Outer wrap
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7. Glue tank
8. Stand-by tape turret

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For the full story on both machine and tape, see your Polyken representative. It can mean maximum protection at minimum investment.

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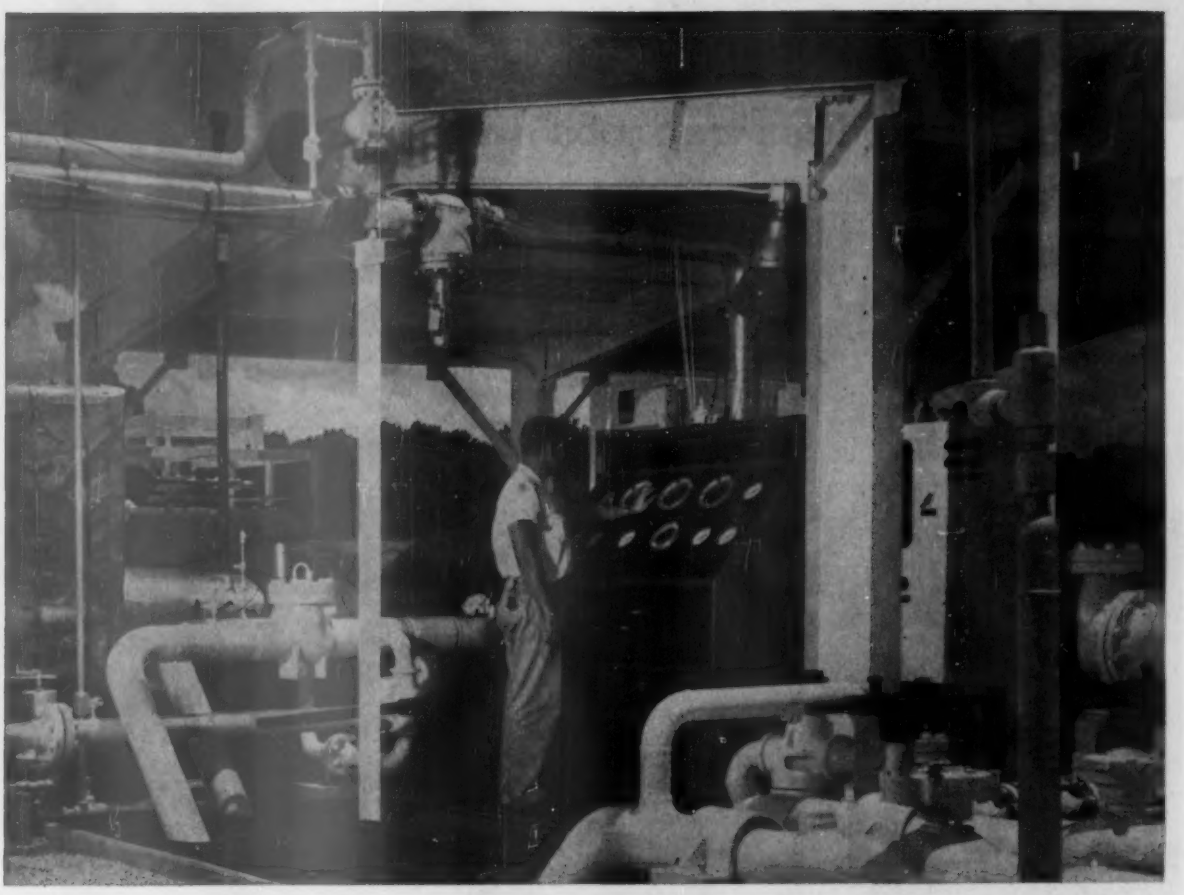

Trunkline uses Solar Gas Turbine compressor in pipeline station

Currently "on-line" at Trunkline Gas Company's Cypress, Texas, pipeline compressor station is an 1100 hp Solar *Saturn* gas turbine-driven centrifugal compressor set. In this application, it pumps up to 60 million cu ft of natural gas per day.

At Cypress, Trunkline is helping to pioneer a new concept: the use of a high-speed, turbine-driven centrifugal compressor in the low-volume range. Traditionally, reciprocating equipment has been the most practical in the range from 75 to 1000 inlet cu ft per minute at up to 1500 lbs pressure.

However, the availability of industrial high speed drivers, such as the Solar *Saturn* T-1000 gas turbine engine, has provided the impetus for Solar to design and build a line of efficient, long-life centrifugal compressors for this range.

The Trunkline installation is 1/10th the size of conventional compressor sets, costs an estimated 2/3rds as much to install and will run on a variety of fuels. At Cypress, for instance, the Solar compressor set runs on natural gas from the line. It would also run on gasoline, diesel fuel, kerosene or LPG fuels.

Another advantage of Solar compressor packages is the fact that a complete turbine-driven 1100 hp unit weighs less than 10,000 lbs and occupies under 300 cubic feet of space. It is easily portable.

Solar compressors are also ideal for field boosting. One *Saturn* turbine-powered set will deliver as high as 100 million cu ft per day. A unique modular concept of interchangeable compressor staging allows quick, easy field changes to accommodate changing pressure and flow requirements.

Solar's industrial turbomachinery is designed for rugged use. Solar turbines start instantly without warm up and are ideal for remote or unattended operation. Ranging from 50 to 1100 hp, they can deliver more power per pound than conventional engines for pumping, electric power generation, oil well servicing and other prime mover requirements.

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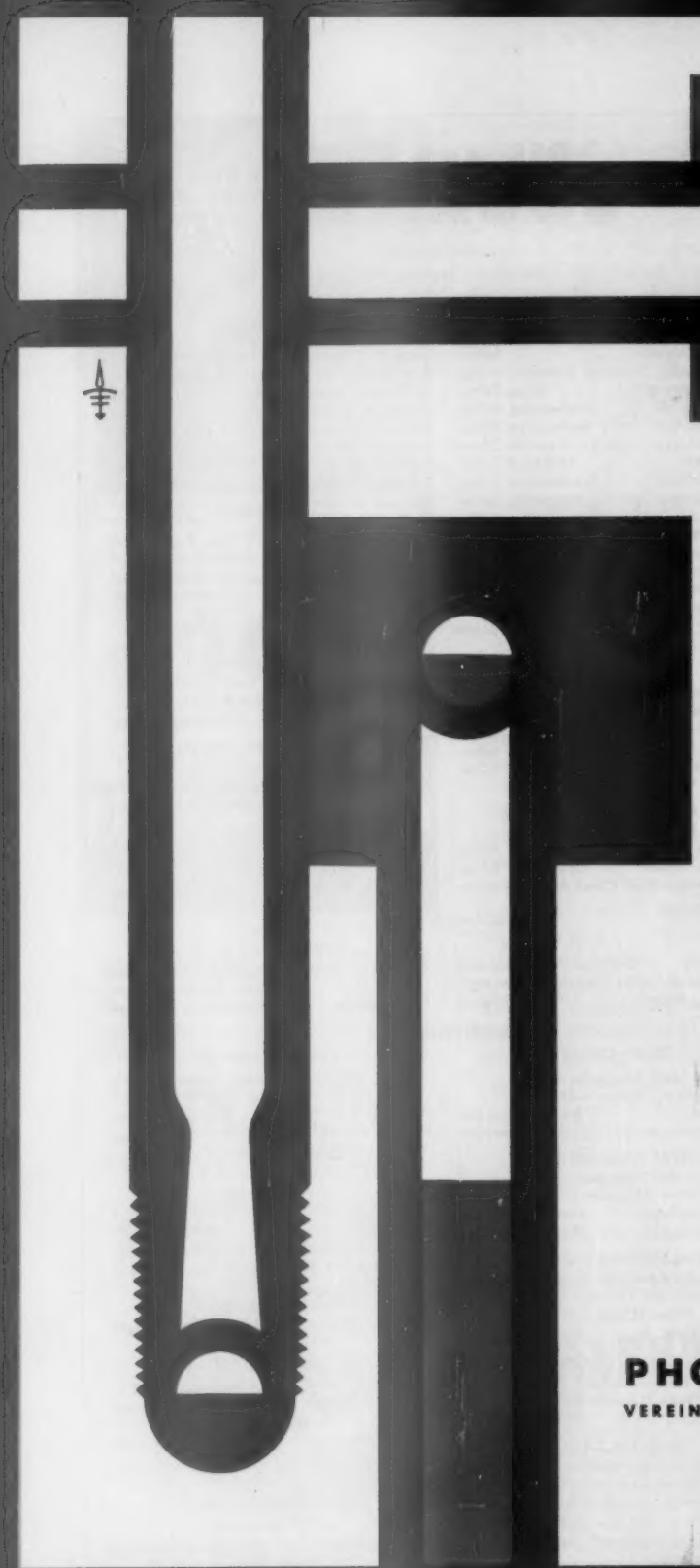

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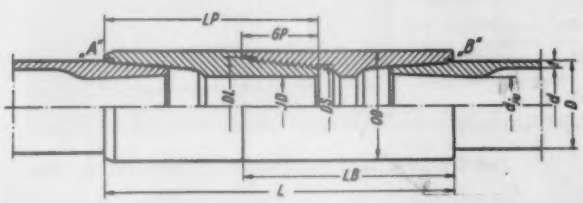

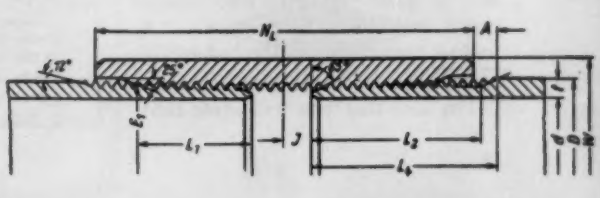

They Say—

Ruble shortchanged

Dear Sir:

I want to compliment you on your very interesting series of articles on "Where Russian Gas Is Headed" (by William R. Connole, OGJ, Aug. 7, p. 81; Aug. 14, p. 86; Aug. 21, p. 62; and Aug. 28, p. 58).

However, I should also like to point out an inaccuracy in this series, specifically in the issue of August 21.

In converting rubles to dollars, the factor of 1 ruble equals 90 cents is used; actually, the factor should be $1 equals .90 ruble. Thus, the 80,000 new rubles referred to at the bottom of the second column on page 65 correspond not to $72,000 as printed, but rather to $88,000.

Alexander Bogrow
Director of European Operations
Arthur D. Little, Inc.
Cambridge, Mass.

Why not wat-er-flo-od?

Dear Sir:

Now that certain oil companies have been dehyphenated (OGJ, Aug. 28, 1961, Journally Speaking, p. 33), I have wondered if waterflooding techniques based on water-flooding theory and water flooding experience, using present types of water-flood equipment are the proper way to water flood a waterflood prospect.

A confused water (?) flooder,
Charles R. Criss
Oilfield Research, Inc.
Evansville, Ind.

The industry might prefer "hydroflood" since prefixes are not hyphenated.—Ed.

A qualified hobgoblin

Dear Sir:

With reference to your Journally Speaking on page 33 of the August 28 issue ("English Spoke Here"), may I point out that the correct quote from Mr. Emerson is, "A foolish consistency is the hobgoblin of little minds" (underscoring mine).

I'm sure that you will agree that

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some consistency is desirable—for example, breathing—and that the sense of R. W. E.'s words change with omission of the adjective.

And concerning your final paragraph, I know librarians wouldn't (follow a universal authority on style), for lack of consistency in agreeing on the "universal" authority.

Roger M. Martin
Chief Librarian
Shell Development Co.
Emeryville, Calif.

What goes down should go up

Dear Sir:

I wish to commend you on your excellent editorial in the August 28 issue entitled "Gasoline Market Wars Endanger Crude Prices" (p. 35).

From our viewpoint one further assertion might properly have been added: If refiners are justified in considering a cut in crude prices now (we categorically assert that they are not), then they should have fostered an increase in inadequate crude prices during their periods of exceptional prosperity earlier this year. Not a single purchasing company did so.

If crude prices are cut at the present time, it will amount to a shameful betrayal of the producers, who, in general, and at best, are now liquidating their reserves at less than replacement cost.

Tom L. Schwinn
Executive Vice President
Kansas Independent Oil and Gas Association

Letters to They Say should be addressed to The Editor. The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

SEPTEMBER

24-27 American Institute of Chemical Engineers, national meeting, Lake Placid Club, Lake Placid, N. Y.

24-27 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Muehlebach Hotel, Kansas City.

25-27 Texas Mid-Continent Oil and Gas Association, annual meeting, Texas Hotel, Fort Worth.

25-28 American Welding Society, fall meeting, Adolphus Hotel, Dallas.

OCTOBER

1-4 American Gas Association, annual convention, Dallas.

3-4 University of Kansas, ninth annual

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gas measurement institute, National Guard Armory, Liberal, Kans.

4-6 American Association of Oilwell Drilling Contractors, annual meeting, Rice Hotel, Houston.

4-6 American Society of Mechanical Engineers, process-industries conference, Shamrock-Hilton Hotel, Houston.

4-6 American Society of Photogrammetry, semiannual convention and technical exhibit, Biltmore Hotel, New York.

5-7 Southwestern Legal Foundation, American Association of Petroleum Landmen, third national institute for petroleum landmen, Dallas.

6-8 New Mexico Geological Society, annual field conference, geology of the Albuquerque country, registration Oct. 5, University of New Mexico, Albuquerque.

8-11 Society of Petroleum Engineers of AIME, annual fall meeting, Memorial Auditorium, Dallas.

12-13 California Natural Gasoline Association, annual fall meeting, Lafayette Hotel, Long Beach, Calif.

15-17 National Association of Oil Equipment Jobbers, annual convention and trade show, Mayflower Hotel, Washington.

15-18 American Petroleum Credit Association, annual conference, Shamrock-Hilton Hotel, Houston.

17-19 American Society of Mechanical Engineers, American Society of Lubricating Engineers, lubrication conference, Morrison Hotel, Chicago.

18-20 Rocky Mountain Oil and Gas Association, annual convention, Denver-Hilton Hotel, Denver.

18-21 American Association of Petroleum Geologists, Mid-Continent regional meeting, Amarillo, Tex.

19 West Central Texas Oil and Gas Association, annual meeting, Hotel Windsor, Abilene, Tex.

19-21 National Society of Professional Engineers, fall meeting, Hotel Roanoke, Roanoke, Va.

19-22 Louisiana Gulf Coast Oil Exposition, Lafayette, La.

20 American Institute of Chemical Engineers, South Texas section, annual technical meeting, Moody Civic Center, Galveston, Tex.

24-25 Pennsylvania Grade Crude Oil Association and Pennsylvania State University Mineral Industries Experiment Station, technical conference on oil recovery by solvents, Pennsylvania State University campus, University Park.

24-25 University of Kansas, Southwest Kansas Center, sixth annual natural-gas pipeline institute, Court House, Liberal, Kans.

24-27 National Association of Corrosion Engineers, south-central region conference and exhibition, Shamrock-Hilton Hotel, Houston.

25-26 National Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

25-27 Gulf Coast Association of Geological Societies, annual meeting, Granada Hotel, San Antonio, Tex.

27 Natural Gas Processors Association, southern regional meeting, Carlton Hotel, Tyler, Tex.

29-31 Independent Petroleum Association of America, annual meeting, Shamrock-Hilton Hotel, Houston.

29- National Lubricating Grease Insti-

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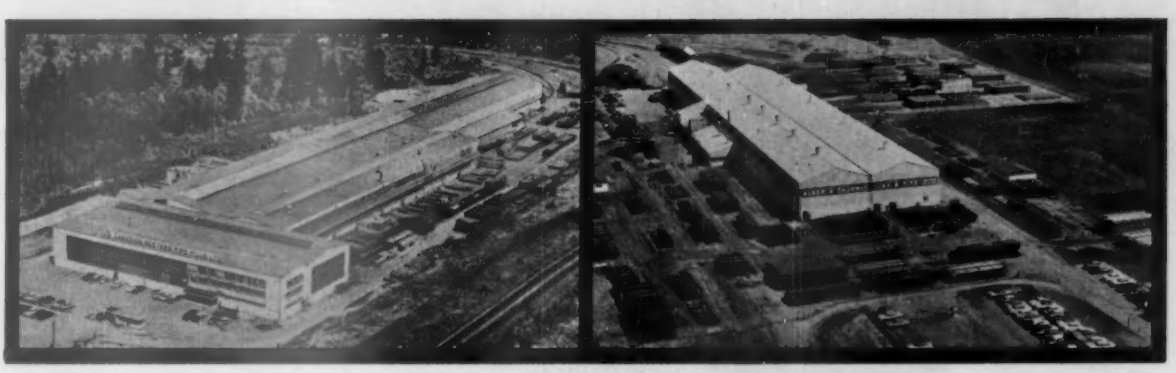

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489

Nov. 1 tute, annual meeting, Rice Hotel, Houston.

NOVEMBER

1-3 Southwest Federation of Geological Societies, annual meeting, Hilton Hotel, El Paso, Tex.
2-3 Society of Petroleum Engineers of AIME, annual California regional meeting, Hacienda Motel, Bakersfield, Calif.
2-3 API, annual agriculture-petroleum seminar, Louisiana State University, Baton Rouge.
2-4 Geological Society of America, annual meeting, Cincinnati, Ohio.
5-9 Society of Exploration Geophysicists, international meeting, Denver.
6-8 Chemical Institute of Canada, conference of the chemical engineering division, Royal York Hotel, Toronto.
9-10 Society of Automotive Engineers, national fuels and lubricants meeting, Shamrock-Hilton Hotel, Houston.
13-15 American Petroleum Institute, forty-first annual meeting, Conrad Hilton, Congress and Palmer House hotels, Chicago.
16 Illinois Oil and Gas Association, annual meeting, Mount Vernon, Ill.
17 Natural Gas Processors Association, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.
26-Dec. 1 American Society of Mechanical Engineers, winter annual meeting, Statler-Hilton Hotel, New York City.

DECEMBER

3-6 American Institute of Chemical Engineers, annual meeting, New Yorker Hotel, New York City.
4 AIME's Society of Petroleum Engineers, Arizona section, annual meeting, Pioneer Hotel, Tucson.
4-6 Interstate Oil Compact Commission, annual meeting, Denver Hilton Hotel, Denver.
5-6 National Petroleum Refiners Association, computer conference for refiners, Hotel Tulsa, Tulsa.

JANUARY

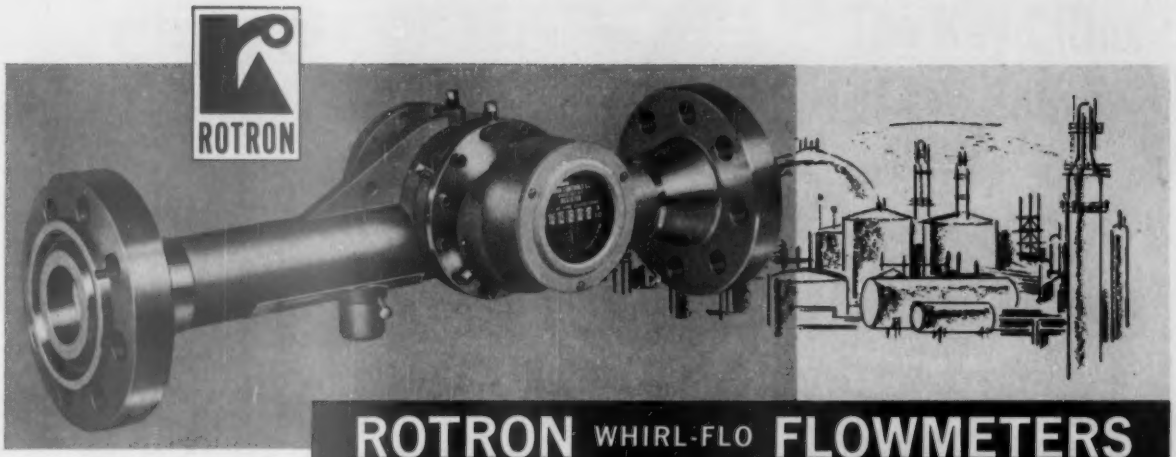
7-10 Pipe Line Contractors Association, annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.
8-12 Society of Automotive Engineers, annual meeting, Cobo Hall, Detroit.
16-18 Kentucky Petroleum Marketers Association, annual meeting and convention, Brown Hotel, Louisville, Ky.
19 Natural Gas Processors Association, Gulf Coast regional meeting, Robert Driscoll Hotel, Corpus Christi, Tex.

FEBRUARY

4-7 American Institute of Chemical Engineers, national meeting, Statler Hotel, Los Angeles.
14-17 Pipe Line Contractors Association of Canada, Castle Harbor Hotel, Bermuda.
15-17 Southwestern Legal Foundation, annual institute on the law of oil, gas, and taxation, Southwestern Legal Center, Dallas.
18-22 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, New York City.
27-Mar. 2 International Oil and Gas Educational Center, institute on economics of the gas industry, Southwestern Legal Center, Dallas.
28-Mar. 2 American Petroleum Institute, Division of Production, southern district meeting, Rice Hotel, Houston.

MARCH

2 Ohio Oil and Gas Association, winter meeting, Deshler Hilton Hotel, Columbus, Ohio.
4-8 American Society of Mechanical En-



ROTRON WHIRL-FLO FLOWMETERS

accurately and economically measure liquid or gas flow in a simple, compact, high-capacity unit

There's no substitute for results when it comes to proving product performance. And results with Rotron Whirl-Flo Flowmeters are proving to many demanding users in the petroleum, natural gas, chemical, petrochemical and food processing industries the inherent accuracy and economy of the Rotron Vortex-Velocity design. Consider the following applications, for example:

WIDE-RANGE OF APPLICATIONS

Proven applications for Rotron Whirl-Flo Flowmeters include measurement of gas produced from oil or gas wells, measurement of gas or water used for oil well injections, and metering oil. In refining and petrochemical service you will find Rotron meters used for in-process control, accounting for final production, and product blending. Chemical uses range from measurement of liquid fertilizers to LPG and other hydrocarbons, including fuel metering in jet engine test stands. Metering the flow of pineapple juice is only one of many functions in food processing. And in the power field, Rotron has proven highly efficient for peak shaving operations in gas distribution systems. Yes, the meter handles viscous fluids and liquids with suspended solids.

Experienced Rotron application engineers are ready at all times to study your specific requirements. Qualified Rotron field engineers, capable of recommending the most efficient flowmetering systems, are available at your call.

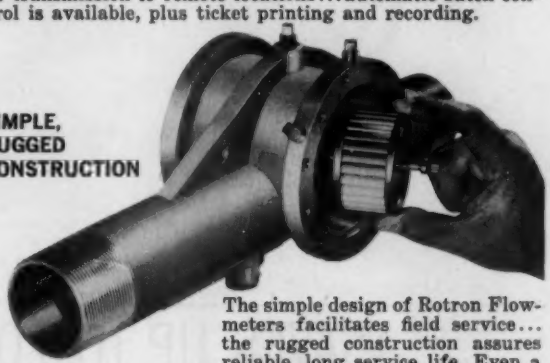
ECONOMY OF INSTALLATION AND SERVICE

The high degree of accuracy, the inherently larger capacity compared with other meters size for size, and the low installation cost, all contribute to the amazing economy of Rotron Whirl-Flo Flowmeters. Rotron is your best buy for direct totalization...no electrical power required.

VERSATILITY OF READOUT

Rotron also offers direct readout of flow rate at the meter or transmission to remote locations...automatic batch control is available, plus ticket printing and recording.

SIMPLE, RUGGED CONSTRUCTION



The simple design of Rotron Flowmeters facilitates field service... the rugged construction assures reliable, long service life. Even a salesman can replace the rotor unit in 10 minutes without removing the meter from the line, without special tools.

ROTRON WHIRL-WEIGH GAS DENSITOMETER

Can be mounted directly on the Rotron Flowmeter for mass flow measurement...also adaptable to existing orifice meters for mass flow. It can also be used independently as a gas density analyzer. Uses cover a wide variety of gases.

GENERAL SPECIFICATIONS

Pressure Rating: 2-inch meters 1500 psig; 3-inch meters and larger 2000 psig.

Pressure Drop: for liquids less than 7 psig at max. flow; for gases usually less than 100 inches water at max. flow rate.

Sizes: models available from 2-inch to 16-inch for liquids or gases.

Accuracy: depends upon meter size; usually ±0.5% or better over 10:1 span. Repeatability better than ±.2%.

Standard Materials of Construction: 2-inch meter stainless steel; other sizes carbon steel; other materials available.

Connections: 2-inch meter threaded ends or flanges; 3-inch meter and larger flanges.

Capacity: liquid capacities range from 10 to 100 gpm for the 2-inch meter to 1400-21,000 gpm for the 16-inch meter; typical gas capacities range from 100-1000 scfm at 100 psi in a 2-inch meter up to 20-150 mmscfd in a 16-inch meter at 100 psi.

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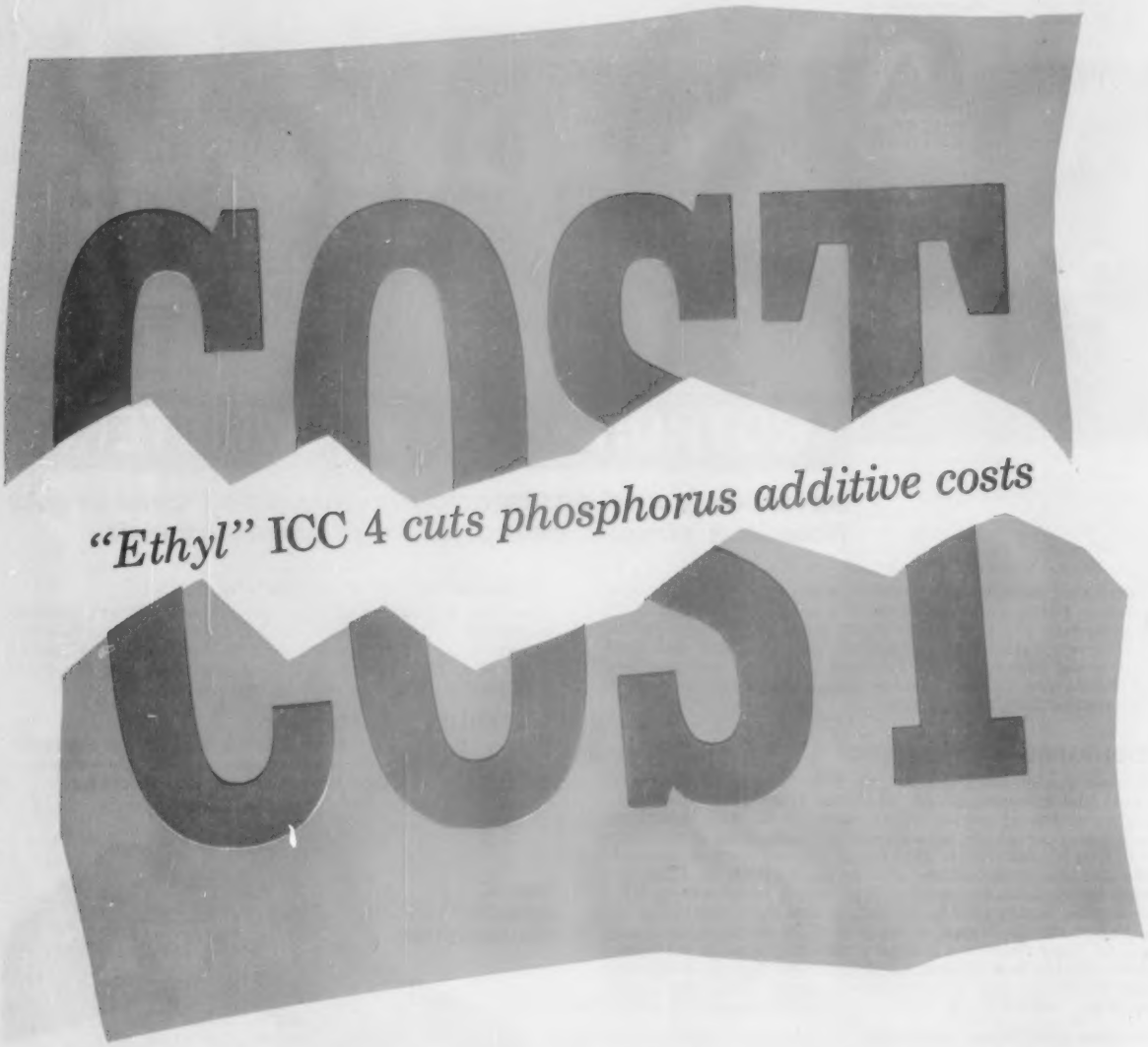

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mined underground storage caverns for LPG shown on the Products Pipe Lines map in this issue of the Oil & Gas Journal.

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gineers, gas turbine-process industries conference, Shamrock Hilton Hotel, Houston.

16 Natural Gas Processors Association, Oklahoma regional meeting, Sheraton-Oklahoma Hotel, Oklahoma City.

18-22 National Association of Corrosion Engineers, meeting, Municipal Auditorium, Kansas City, Mo.

19-22 Kentucky Petroleum Marketers Association, management institute conducted by the University of Louisville, Brown Hotel, Louisville, Ky.

21-23 New England Gas Association, annual meeting, Statler-Hilton Hotel, Boston.

21-23 American Petroleum Institute, Division of Production, southwestern district meeting, Lincoln Hotel, Odessa, Tex.

26-29 American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, joint annual meeting, Fairmont Hotel, Civic Auditorium, San Francisco.

APRIL

3 Chemical Institute of Canada, chemical economics division conference, Royal York Hotel, Toronto.

4-6 API, Division of Production, Mid-Continent district meeting, Sheraton Oklahoma Hotel, Oklahoma City.

9-10 Instrument Society of America, national chemical and petroleum instrumentation symposium, Wilmington, Del.

11-12 Petroleum Industry Electrical Association and Petroleum Electric Supply Association, convention and exposition, Dallas.

11-13 API, Division of Production, Rocky Mountain district meeting, Hilton Hotel, Denver.

15-18 American Society of Mechanical Engineers, oil and gas power division conference, Shoreham Hotel, Washington.

17 Society of Plastics Engineers, Philadelphia section, regional technical conference, Sheraton Hotel, Philadelphia.

17-19 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman.

17-19 American Society for Metals, regional conference and exhibition, materials and materials processing for the petroleum, petrochemical and chemical industries, Shamrock Hilton Hotel, Houston.

23-25 American Association of Petroleum Geologists, Rocky Mountain section annual meeting, Salt Lake City.

25-27 Natural Gas Processors Association annual convention, Hilton Hotel, Denver.

29-May 1 Independent Petroleum Association of America, midyear meeting, Hotel Muehlebach, Kansas City.

29-May 2 Liquefied Petroleum Gas Association, annual convention and trade show, Conrad Hilton Hotel, Chicago.

29-May 2 Southern Gas Association, annual meeting, and American Gas Association, transmission conference, Rice Hotel, Houston.

MAY

10-11 API, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Odessa, Tex.

11 Natural Gas Processors Association, Permian Basin regional meeting, Lincoln Hotel, Odessa, Tex.

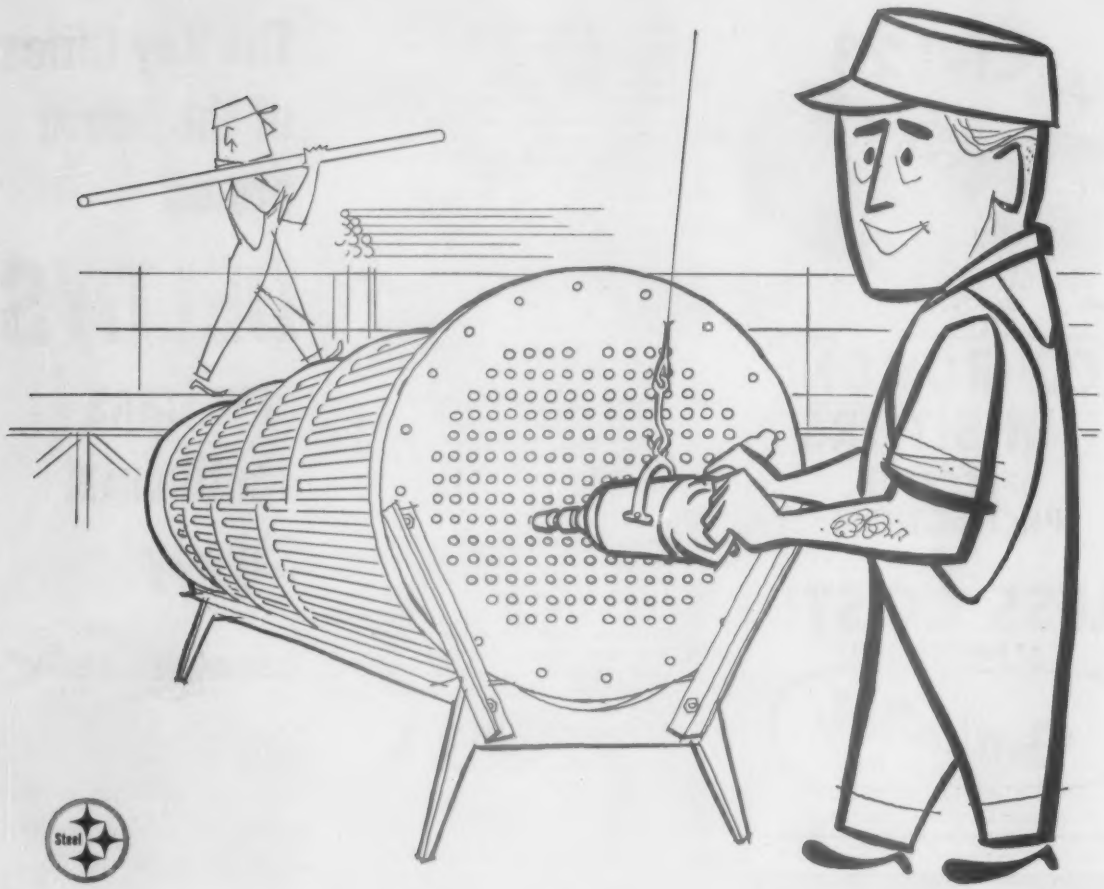
14-17 API, Division of Refining, midyear meeting, Fairmont and Mark Hopkins Hotels, San Francisco.

The Key Cities of the South are on DELTA'S new trans-continental Skyway

Delta's big jets over a new Southern Transcontinental Route now enable you to include important cities across the South on a coast-to-coast trip. Los Angeles, Dallas, Fort Worth, New Orleans and Atlanta all lie along Delta's new jet skyway. Plus DC-7's between San Diego/Las Vegas and the Southeast. And October 15, Delta inaugurates service to San Francisco.

DELTA

A New Southern Transcontinental Route



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Uniformity of dimensions. Strength of weld. Proper combination of physical and mechanical properties. This is the way B&W produces its Lectrosonic® carbon steel heat exchanger tubing to be sure it fits perfectly and rolls in easily for fast, economical installation.

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the Journal said...

JOURNALLY SPEAKING

50 years ago

September 28, 1911

The world's largest holder for the storage of natural gas is being erected in Pittsburgh, Pa., at a cost of $500,000. It will be 208 ft. high with a diameter of 226 ft., and will have a capacity of 6 M.M.c.f. of gas. Its steel plates will be 1⅞ in. thick, and require more than 1,500,000 rivets, 2 in. in diameter.

Producers Oil Co. has brought in its No. 2 Foster a mile north of Humble field, north of Houston, as the deepest producer on the entire Gulf Coast region of Texas and Louisiana. Its depth of 2,900 ft. is more than 200 ft. greater than that of the previous deepest producer, also at Humble and completed earlier this year at 2,705 ft.

Interstate Commerce Commission launches its inquiry into the pipeline industry and its operations. Initial taking of testimony at Houston to be followed by hearing later this week at Tulsa. Hearings covering all fields are expected to continue 6 months.

25 years ago

September 24, 1936

Tide Water Pipe Co., Ltd., completes 58 years of continuous operation in transportation of Pennsylvania Grade crude from fields in northwestern Pennsylvania to refineries on the Atlantic Coast. Initial line, laid in 1878, was 102 miles long, and laid with 6-in. pipe, the largest ever used.

Old Ocean field, in Brazoria County, Texas Gulf Coast, reclaims world's producing depth record. Harrison & Abercrombie bring in their 1 Armstrong Plantation flowing 203 bbl. of 54.7° gravity condensate daily through ¼-in. choke from 30 ft. of sand at 9,963 ft. New depth exceeds previous record held by Lafitte field, in South Louisiana, with production from 9,600-ft. sands.

10 years ago

September 27, 1951

Texas Railroad Commission plans drastic action to check flaring of natural gas. Monthly volume of flared gas estimated at 5,500 M.M.c.f., an increase of 137% since January. Tremendous waste of gas is condemned.

Newly issued Texas oil-proration order sets allowable production for October at new all-time high of 3,115,512 bbl. daily.

General Petroleum Corp. drills 13,425 ft. of open hole in deep wildcat test in Huron area of Kings County, California, to set new state record for open-hole footage. Hole size ranged from 12¼ in. in drilling below 13⅜ in. surface pipe at 1,486 ft. to 8¾ in. at total depth of 14,911 ft.

Map-making memo

SOME of you Journal readers may take one look at our new pipeline map in this issue, mentally comment "This is where I came in," fold it up, and put it away. If you did, we invite you to take another, closer look.

You'll find quite a few changes—nearly 300 all told. For example, this new map is gridded and indexed to help you locate the major systems. Also, for the first time in any pipeline map, underground LPG storage sites are located.

If you are an average reader, the rest of the map may look about as original as summer TV. But you unaverage readers who really know your pipelines will be surprised at the new additions. And you're the ones we particularly want to serve when we undertake a map revision like this one.

We start with a base which is about a third larger than the one you get. It shows all the lines as they were in 1959. Then we go to the companies asking for their individual system maps. They cooperate handsomely—79 of them sent us 141 maps this year.

They come in all shapes and sizes, scaled all the way from 1 to 72 miles to the inch. One, measuring 24 by 30 in., showed more than 10,000 miles of line. Another gave us four maps, all to different scales with less than 100 miles of pipelines.

Don't get us wrong, we're not complaining. We're deeply and equally grateful to both.

Sometimes we receive copyrighted road maps. They are perfect but unusable until we get clearance from copyright owners. One company had us fooled for a moment. The map showed only half its system, until we turned it over and found the other half on the reverse side. We couldn't object to this since our own finished product is two maps, back-to-back.

All of these company maps are then blown up or reduced to match the base scale. This is no problem when we have references like state lines to serve as a guide.

Then the whole batch goes to the ablest map maker we know, located in the most inconvenient spot you can imagine. He's Guy Drew and he lives in Aspen, Colo. He then sets to work bringing his original up to date. That done, everything comes back to Tulsa for checking.

That word "checking" seems highly inadequate to the individual involved. There are more than 100,000 miles of oil pipelines stretching over 46 of our 48 contiguous states. Only Virginia and Delaware remain ungraced by crude or product pipelines. And then there's Canada, particularly Alberta. These lines can drive you crazy. They cross and crisscross, parallel and diverge, connect and separate.

This leaves plenty of room for error, and we've probably made some. Henry Ralph, the usual termagantish tenant of this page, offered to bet $50 there would be one. We countered with an offer to bet $1 there would be 50. Fortunately neither was accepted. It would be bad to lose the $50, but worse to win the $1.

Seriously, we haven't found any yet. We hope you like the result and will find these pipeline maps useful. What do you think, incidentally, of the two maps back to back? Would you rather we printed them separately at different times? Let us know.

—John P. O'Donnell

TUBINGLESS COMPLETIONS

Baker has developed a complete new line of products for completions using tubing as small-diameter casing.

The picture shows some of these new products. The complete line very nearly parallels the entire Baker line of conventional-size products.

The line includes: Primary Cementing Equipment (shoes, collars, centralizers, scratchers, turbulizers); Remedial and Stimulation Tools (treating packers; both retrievable and drillable bridge plugs); Production Tools (retrievable and drillable production packers; casing pump packers, tubing anchors).

Many of these new Baker Products are not yet available in quantity, nor in all areas.

Tubingless Completions are becoming more numerous. Our own engineering and development programs continue as Baker keeps alert to the trends—ready to provide the practical and dependable new tools that will further improve tubingless completion methods and techniques.

WE INVITE YOUR INQUIRIES
Please ask your Baker Man for Technical Bulletin 378, or write to Baker Oil Tools, Inc., Box 2274, Terminal Annex, Los Angeles 54, California

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New FPC chairman lays it on the line

THE INDUSTRY has some reason for encouragement as a result of the speech made in Houston last week by Joseph Swidler, new Federal Power Commission chairman.

The most welcome aspect was that Swidler laid his views on the line. There was no pussyfooting.

Bear in mind that Swidler has been chairman only since September 1, and has been on the commission only since midyear. Therefore, it would have been understandable (and boring) had he made a routine speech about how the commission was just getting squared away but that it was working mighty hard to do a great job. Instead, Swidler chose to make some major policy declarations.

SWIDLER MADE IT CLEAR that he is committed to an effort to make the area-pricing approach succeed. And he made definite promises that the commission will spell out specific procedures for itself and the industry.

He left no doubt, either, as to the alternative he foresees should the area-pricing approach fail: a case-by-case utility-type regulation.

If Swidler continues to take a definite stand on key issues—and the indications now are that he will—the industry will at least know what the score is at the FPC. Too many times in the past this has not been true.

THE JOURNAL APPLAUDED the "old" commission last fall when it first adopted the area-pricing approach. This was done not because the Journal considered area pricing the perfect solution but because it represented a definite, positive step forward toward bringing some semblance of common sense, reason, and order out of the chaos into which the FPC's previous regulatory attempts had fallen.

However, after the FPC issued its policy statement, it failed to follow through to provide a pattern. As a result, confusion and doubt developed, both in the industry and at the commission.

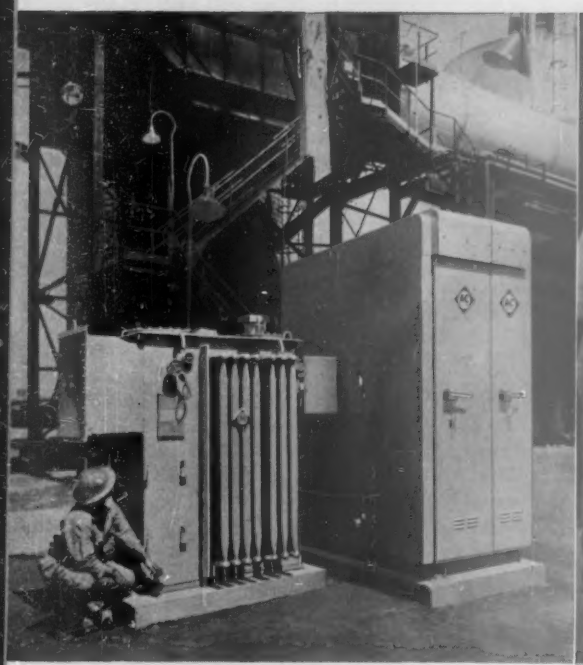
Now Swidler has restated the area-pricing policy. If a majority of the new commission agrees with this, the next big step will be to get the show on the road by evolving specific guidelines.

The industry, for its part, should cooperate to the extent of giving the procedure a fair trial. This does not mean abandoning basic principle. It does mean that the industry should act promptly in supplying information the commission requires, and it means avoiding delay for delay's sake. This is no time for foot dragging.

Therefore, if Swidler and the other commissioners provide the leadership in their area, progress can be made.

The appearance of the first robin is not a sure sign of spring. Nor is the first major speech of a new FPC chairman a sure sign of what lies ahead. But in each instance there is cause for hope.

ideas and news:



Unit substations are "packaged" for lower costs: Allis-Chalmers packaged unit substations reduce your engineering, planning and purchasing time—cut installation and maintenance costs, too. Located close to the load center, they provide reduced power losses, better regulation, flexibility for expansion. Oil-filled, CHLOREXTOL liquid-filled and sealed dry-type transformers are available.

By-product power from process steam: Steam is used twice in this ethane cracking plant. It enters the 6250-kw WA-Series steam turbine-generator units at 625 psig. Steam at 65 psig is automatically extracted for use as process steam in the cracking operation. An unusually simplified control and hydraulic valve-actuating amplification system minimizes maintenance and improves performance of these units. Allis-Chalmers complete line of turbine-generators includes condensing and non-condensing types in ratings of 2000 kw and larger.

Which of these productive ideas could be working for you?

Motor controls that are safe in hazardous locations. Open motors that "thrive" outdoors. Efficient pumps for volatile liquids. These examples demonstrate the extra value that is standard with A-C ...the greater efficiency and the added productivity which are yours when you buy A-C products, systems and services. Call your Allis-Chalmers representative for details on A-C "worth-more" features. Or write Allis-Chalmers, Milwaukee 1, Wisconsin

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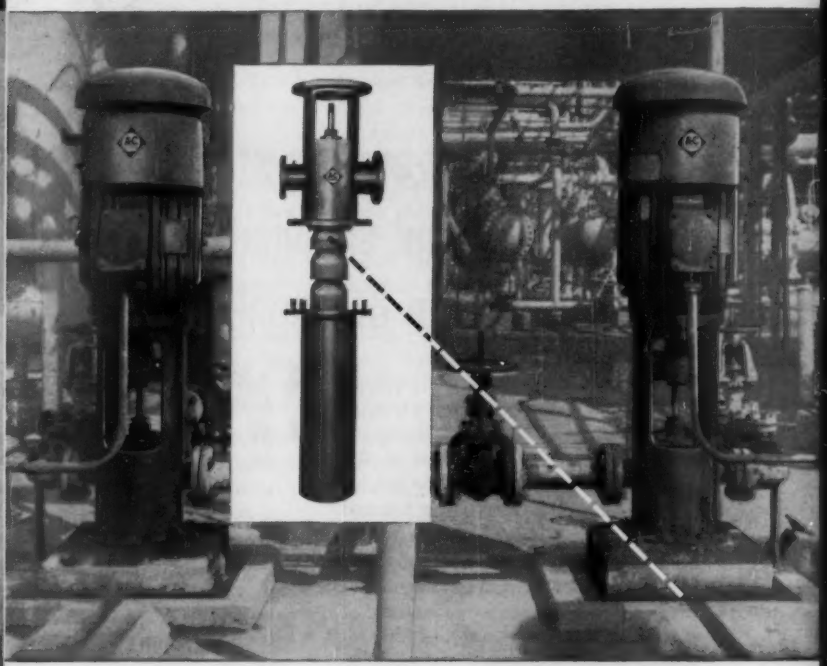
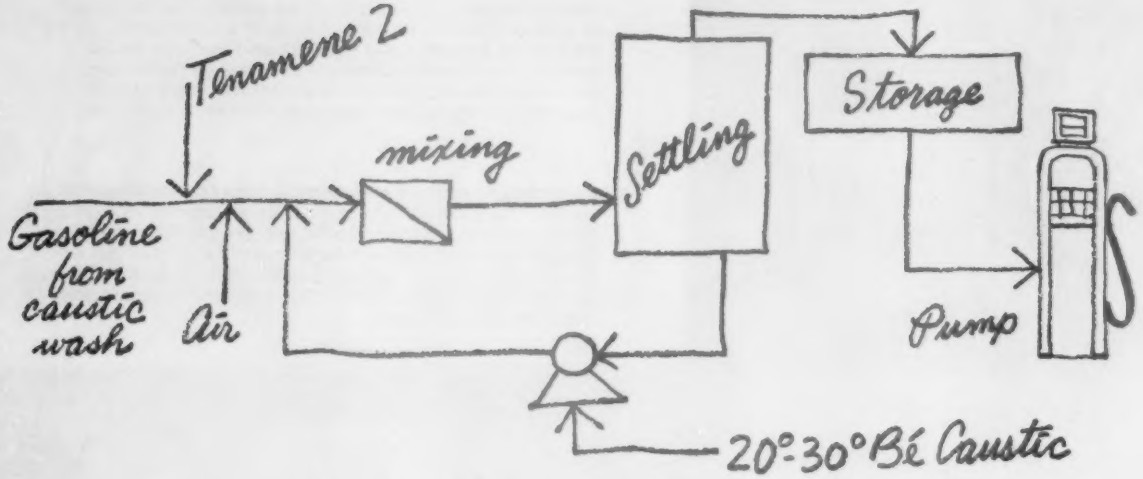
Short lesson on pumping volatile liquids: Use UNITANK pumps. These vertical turbine pumps are often the solution to NPSH pumping problems. Mounting of the impellers and bowl assemblies within a suction tank assures that impellers are always submerged . . . prevents fluids from vaporizing. Total dynamic heads from 20 to 400-plus feet are available, capacities from 20 to 3500 gpm.



Open motor's at home on the range: This SUPER-SEAL open motor fights off prairie dust (and rainstorms, too), thanks to remarkable POXEAL insulation. This Allis-Chalmers development enables open motors to resist dust, moisture, abrasives and contaminants. And the open design of SUPER-SEAL motors gives a higher service factor than TEFC types.

ALLIS-CHALMERS PRODUCTS FOR THE PETROLEUM INDUSTRY: Look to Allis-Chalmers for controls, rectifiers, switchgear, transformers, capacitors, circuit breakers, industrial systems, motors, pumps, compressors, valves, engine-generators, water conditioning equipment, thermal, hydro and atomic electrical generating equipment, earth moving equipment, tractors, lift trucks.

ALLIS-CHALMERS



For gasoline stocks that respond, the economy and simplicity of Tenamene 2 inhibitor sweetening can seldom be equalled by any other treating method

In the presence of caustic and oxygen, Tenamene 2 catalyzes the conversion of mercaptans to disulfides. Being insoluble in caustic, it remains in the gasoline stream to effectively inhibit the formation of gum in the finished gasoline. Thus, it both sweetens and inhibits in essentially one operation.

Tenamene 2 inhibitor sweetening is primarily of interest to processors of catalytically-cracked gasoline. The response of sueh gasolines to the inhibitor sweetening method can be quickly determined by the following test:

1. Using sour gasoline from the primary caustic scrubber or mercaptan removal unit, put 700 ml. into each of several one-quart bottles.
2. To one group of samples, add Tenamene 2 at a rate of 5 pounds/1,000 bbls. (14.25 mg./liter). To another, add 10 pounds/1,000 bbls. (28.52 mg./liter).
3. Add 10 vol. % of 15° Baumé caustic to each sample.
4. Stopper the bottles, shake thoroughly. Replace stoppers with notched corks and store samples in a dark place at room temperature.
5. Examine at 3-hour intervals and determine the time required for sweetening.

If the results of this test indicate Tenamene 2 inhibitor sweetening to be effective in treating your sour gasoline, we will be glad to aid you in making a detailed study of your sweetening and stabilization requirements. In this study we will help you determine the optimum processing values for your particular operation, including inhibitor concentration, caustic strength and proportion, acid oil content, process temperature and reaction time. For an evaluation sample of Tenamene 2 and more information on the Tenamene 2 inhibitor sweetening method, write or call your Eastman representative, or write to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Basic Procedure for Tenamene 2 Inhibitor Sweetening
(see sketch)

The sour gasoline is washed with 10-15° Baumé caustic. Between 5 and 15 pounds of Tenamene 2 is added per 1000 barrels of hydrocarbon. A small quantity of air is injected into the stream and the gasoline contacted with 20°-30° Baumé caustic. The gasoline is allowed to settle, then pumped to storage. If not already sweet when it goes to storage, the gasoline should sweeten within a few hours after storage.

Tenamene 2 inhibitor sweetening is, in almost every instance, more economical than doctor or copper chloride sweetening. Unlike doctor treating, no regeneration step is necessary, and there is no reduction in tetraethyl lead response. Unlike copper chloride treating, Tenamene 2 inhibitor sweetening does not allow the possibility of gum-catalyzing, copper contamination.

Most refineries find that minor modification of existing procedures enables them to adopt this method.

Tenamene 2
an Eastman gasoline additive

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; Atlanta; Boston; Buffalo; Chicago; Cincinnati; Cleveland; Detroit; Greensboro, North Carolina; Houston; Kansas City, Missouri; New York City; Philadelphia; St. Louis.
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What Congress Is Leaving Undone

• Oil import controls, antitrust proposals may stir up the biggest storms in the 1962 session. Taxes and depletion will come in for legislative attention, too, but no major changes are expected in these areas.

Clyde La Motte
Washington Editor

THE 87th Congress is currently winding up its first-half performance. After a pause for back-home "commercials," it will resume the last half of its work in January.

This between-halves break gives the oil industry an opportunity to size up what Congress has done thus far and what it may do in 1962.

1. This Year

For a starting point, look at the major oil-related actions taken by Congress:

... **A fuels study** was authorized by the Senate, setting the stage for an eventual committee report which could include recommendations for specific legislation.

... **The federal gasoline tax** of 4 cents a gallon, which was to have dropped to 3 cents at midyear, was extended to 1972.

... **A wilderness bill** was passed by the Senate. This had little immediate impact on the industry, but over the long haul it tends to rule out oil development of large areas of public lands. However, the House did not act on the legislation.

... **A minimum wage bill,** which will move minimum wages up to $1.25 an hour on a graduated basis, was passed.

Most oil marketing operations were exempt from the overtime provisions of this legislation. But a preliminary Labor Department ruling that federal gasoline taxes must be included in determining a company's gross may pull many smaller operators under the provision of the new law.

... **A water-pollution bill,** giving the federal Government more power and more money to spend on cleaning up water supplies, was written into law.

Of the above, the fuels - study authorization clearly has the broadest ramifications. Coal has two clear-cut targets in this study, and in a similar "maverick" study being undertaken by a House subcommittee. The targets are: Continued restrictions on residual fuel-oil imports and — more important — the eventual ban of natural gas as a boiler fuel.

It is unlikely, however, that these committees will be able to wind up their work and make reports in time to permit any congressional action on these issues in 1962.

Furthermore, the committees appear to be well-balanced enough to rule out the likelihood of any drastic proposals for major legislation affecting the fuels picture. This is particularly true of the Senate committee, to be headed by Sen. Clinton Anderson (D.-N. M.).

2. Next Year

The biggest oil-related issue in Congress next year is likely to be the oil-import-control program.

There will be considerable talk about taxes, too, including percentage depletion, but no major changes are likely in 1962.

Various antitrust legislation, including the perennial bill to eliminate "good faith" as a defense in price discrimination, will get fresh impetus. So will other legislation aimed at banning "below-cost" sales.

Premerger notification will get serious consideration, as will the proposal backed by the Justice Department to give it authority to subpena company records in civil investigations.

Import controls . . . A showdown fight over some phases of the oil-import-control program is virtually certain.

There is no likelihood that controls will be abandoned. Not on crude-oil imports, anyway.

Just how brisk the fight will be depends to a large extent on what action is taken before next January by Interior Department, which currently has the program under study, and by the Office of Civil and Defense Mobilization, which is taking a new look at whether residual-fuel-import restrictions are essential to national security.

But there will be a big fuss on whether resid controls are to be continued or eased.

If they are eliminated or relaxed substantially, you may be sure that coal-state congressmen will propose legislation to force a resumption.

If resid controls are tightened, or even left as they are, the New England congressional delegation will undoubtedly raise Cain, for New England wants more residual fuel oil imports.

To further spotlight the imports issue generally, the Reciprocal Trade Act comes up for renewal next year. An all-out effort will be made by the so-called protectionists to gain either higher tariffs or tighter import controls on a wide range of products. Oil could become involved in that fight.

And bear this in mind: Although Congress may take no direct action next year affecting oil-import controls, heavy pressure by a strong segment of Congress could have a definite impact on Interior's handling of the program.

Taxes . . . The Kennedy administra-

tion has said it will offer Congress next year a stem-to-stern overhaul of the present tax structure. If so, this will naturally become a major issue.

However, there are definite signs that the showdown will not come in 1962.

For one thing, the administration apparently is far from being ready with new proposals. And the licking it took this year on the "interim" tax revisions it offered is likely to make the administration cautious about rushing in with any far-reaching proposals.

Also, Congress doesn't appear to be in the mood for such an overhaul. A high-ranking member of the House Ways and Means Committee — where tax legislation must originate—privately backs up this statement. He says the reciprocal-trade extension and other individual issues will probably keep the committee so busy next year it will not have time to get around to considering major overhaul proposals, even if the White House sends such proposals up to the Hill.

What is more likely: There will be consideration of individual changes here and there in the overall tax structure. The extent of this tinkering depends largely on the Government's revenue situation. If, for instance, the preparedness program is stepped up considerably, more revenue would be required. This would force Congress to look for means of doing this.

If, on the other hand, tensions should ease substantially, causing the economy to relax, a proposal to speed up depreciation allowances for investments in new plants and equipment would have a good chance.

As for percentage depletion, one can assume that it will come under attack somewhere along the line next year. But as things stand now, no serious drive for a cut is in sight.

It would take a deliberate effort by President Kennedy to make oil's percentage depletion a real issue next year, and the President has shown no indication that he plans such a move even though some of his top Treasury Department and Internal Revenue Service officials have taken potshots at the provision.

Natural gas . . . The prospects for any legislation next year to help the natural-gas producer are exceedingly slim.

Note that no action was taken this year on the proposals made by Rep. Oren Harris (D.-Ark.).

Furthermore, the fact that a "new" Federal Power Commission is actively engaged now in a fresh effort to get area pricing off the ground is another deterrent to legislative efforts in the near future. That is, Congress will want to wait and see what the new commission accomplishes.

Antitrust . . . The biggest apparent danger to the oil industry in 1962 is in proposed legislation to make antitrust and antimerger laws tougher than ever.

Such legislation will get a strong push from the administration and from a number of congressmen who felt that the advent of the Kennedy administration gave them a fresh opportunity to push their pet projects.

Extra Maps

THE authoritative petroleum-pipeline maps of the U. S. and Canada which accompany this issue are Journal exclusives.

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You Might Have Guessed It: 8 Days for Texas

IT'S more of the unpalatable same for Texas producers in October.

The Texas Railroad Commission has ordered an 8-day crude-producing pattern for October.

It will be the state's sixth straight month on 8 days—the lowest level ever reached by per-well allowables in Texas.

October's total daily calendar allowable was fixed by the commission at 2,683,214 bbl.

Due to the longer month, it represents a drop of 16,326 bbl. daily from the initial allowable for September and of 39,788 bbl. daily from that in effect September 2.

Crude purchasers reached a new peak in unanimity of nominations. All but one, Sun Oil Co., sought 8 days. Sun asked for 9. A few purchasers testified they would need to buy minor quantities of spot oil on the 8-day schedule.

The statewide hearing broke in a new commissioner, Ben Ramsey who was sworn in as the third member of the commission a day earlier (see p. 110).

Ramsey, long-time lieutenant gov-

Higher runs reported for August

Company—	Avg. in. bbl. daily*	% of Capacity
Petrofina	27,302	91.0
Atlantic Ref.	208,207	99.2
Bell	6,752	84.4
Bryson Pipe Line	394	36.0
Cities Service	265,841	90.7
Continental	195,682	101.3
Cosden	38,105	88.6
Crown Central	34,664	86.7
Danaho Refining	3,987	33.2
El Paso Natural	20,845	94.8
Gulf	489,369	86.8
Humble	793,000	82.4
Indiana Oil†	642,300	89.2
LaGloria	17,055	71.1
Monarch	2,268	57.0
Ohio	102,405	92.7
Permian	2,168	54.2
Phillips	230,300	84.0
Plymouth	41,057	91.2
Premier	12,532	56.0
Pure	174,012	93.1
Shamrock	25,627	94.9
Shell	552,614	93.0
Signal	57,656	96.0
Sinclair	446,282	91.3
Skelly	51,568	95.0
Socony Mobil	570,000	79.5
Sohio	161,225	94.6
Standard (Tex.)	48,133	64.2
Sun	204,569	80.2
Suntide	41,363	63.6
Texaco	724,606	98.1
Tidewater	251,548	91.5
Others	1,039	86.0
August total	6,444,475	
July total	6,263,841	

*As reported to The Texas Railroad Commission. †Consolidated Standard Oil (Ind.).

ernor of Texas, succeeded the late Olin Culberson on the commission.

Culberson, known as the "champion of the independent," died June 22 at the age of 74. He was first elected to the commission in 1940 and later was elected to three more 6-year terms.

Rampaging Mobil Well in West Texas Being Subdued After Battle

MOBIL Oil Co.'s wild West Texas wildcat is slowly being tamed.

The roaring gas fire at the company's 1 Effie Potts Sibley in Pecos County was snuffed out for the fourth time September 14. And a Red Adair crew from Houston finally succeeded in capping the well September 19.

At midweek, the high-pressure gas flow from the Wolfcamp zone was being diverted 600 ft. away from the well head through two 6-in. lines below the capping device. Mobil is burning the gas at the end of these lines to reduce danger of further explosions.

Meanwhile, a Parker Drilling Co. rig has been moved in and is rigging up just off the well site. It will be skidded over the hole as the next step in the battle to bring the well under complete control.

Mobil spokesmen declined to comment last week on what happens next. Information also is being withheld so far on the cause of the blowout and the volume of gas flowing from the well.

The blowout appears certain to go down in oil history as the worst such disaster yet from the standpoint of casualties (OGJ, Sept. 18, p. 60).

Casualty figures last week remained the same: Two dead, three missing, and 96 injured, according to Mobil figures. The dead and missing all were employes of Parker Drilling.

An explosion September 9 blew the rig on the Parker project off the hole and onto its side. Debris was cleared away September 12, but hot metal reignited the well. Later it was fired intentionally.

At the time of the explosion roughly 125 men were helping mix and pump mud into the hole. The high-pressure gas flow is from 9,648 ft.

Justice Attacks Honolulu Sale . . .

THE planned purchase of Honolulu Oil Corp. by Tidewater Oil Co. and Pan American Petroleum Corp. ran into a new hurdle last week: A suit filed by the Department of Justice to block the sale.

This occurred just after the Internal Revenue Service announced resumption of ABC rulings (see story below). A favorable ruling on the Honolulu purchase had been expected momentarily.

Then Atty. Gen. Robert F. Kennedy appeared on the scene. Authorizing his staff to file suit, he said the sale would result in "unlawful restraint of trade" and would lessen competition substantially. He said the sale would give the purchasers a decisive advantage over smaller, less diversified competitors.

The suit, filed in the U. S. District Court in San Francisco, asks for preliminary and permanent injunctions.

In addition to Honolulu, Tidewater, and Pan American, the suit lists Standard Oil Co. (Ind.) and Getty Oil Co. as defendants. The reason, the complaint states, is that Pan American is a subsidiary of Indiana Standard and Tidewater is controlled by Getty.

Honolulu, a producing company, reached a decision last year to sell out. Early this year, Tidewater and Pan American made a joint bid for the property and in May an agreement was reached.

. . . As IRS Resumes ABC Rulings

THE Internal Revenue Service is resuming its practice of issuing rulings on the income-tax treatment of ABC-type oil-production sales.

IRS Commissioner Mortimer Caplin emphasized, however, that IRS is still completing its study of ABC transactions and plans to publish precise rules relating to them.

Meanwhile, Caplin said, "requests for rulings on arms-length ABC transactions between unrelated parties will be considered on the merits and rulings issued where appropriate."

IRS had suspended its practice of making such rulings earlier this year, (OGJ, July 24, p. 37). At that time the agency was known to be considering a ruling that a seller would be taxed at the 52% ordinary-income rate rather than at the capital-gain rate of 25%.

However, the IRS withheld the rule change and set up a 30-day period for industry comment. During this period, many organizations and individuals protested that such a step would kill ABC transactions and would be a heavy blow to producers, particularly independents.

Last week's action indicates that the tax agency is much less likely now to go through with its original plan. Instead, IRS may confine itself to spelling out just which type of ABC deals will be eligible for favorable tax rulings and which will not. And IRS will give closer scrutiny to each ABC transaction brought before it.

A clue to this approach was the emphasis Caplin gave to "arms-length" transactions and to "unrelated parties" in his announcement.

The suspension of rulings several months ago left many oil deals up in the air. One of these was the pending sale of Honolulu Oil Corp. to Pan American Petroleum Corp. and Tidewater Oil Co. (see story above.). Another was the proposed sale of Republic Natural Gas Co. of Dallas to Socony Mobil Oil Co. In each, a big factor was a favorable tax ruling.

The IRS resumption of rulings may permit completion of such sales.

Swidler Declares FPC Will Stick With

• New chairman takes the initiative in gas-regulation muddle. Area prices seen as ceiling rather than floor.

JOSEPH C. SWIDLER, the new chairman of the Federal Power Commission, wants to go ahead—full steam—with the area - pricing method of determining rates for natural-gas producers.

He considers it "the most important single tool" for developing a sound regulatory framework, and therefore feels it should be pushed "with all dispatch and vigor."

Swidler's views on area - pricing and other regulatory issues were revealed last week in a speech in Houston and were elaborated upon by him at a press conference in Houston and in a Washington interview. In each instance, the chairman stressed that he was expressing his own views, and not necessarily those of a majority of the commission.

The chairman's outright support of area pricing will undoubtedly give fresh impetus to area-rate proceedings now in preliminary stages in the Permian basin and southern Louisiana. These, in turn, will help set the pattern for future proceedings in other areas.

There had been times in recent months when it appeared that the area - price approach had bogged down completely. And the advent of a majority of new commissioners raised speculation that the procedure might be abandoned or changed drastically.

It seems evident now that this will not happen, at least not until a renewed effort has been made to get positive results with the area approach.

Pricing approach . . . It is clear that the new chairman feels that no real progress can be made until comprehensive ground rules are established.

It is equally clear that he considers it the commission's duty, and not that of the industry, to develop a workable procedure. Therefore, the first target of the commission will be to spell out basic rules and guidelines.

Swidler did not promise when this would be done, but he said. "It is my earnest hope that we will have the answers, or a bulk of them, in the near future."

Swidler already has some definite ideas on the basic pattern of the area-pricing approach.

For one thing, he feels that while costs must be considered, costs should not be the sole nor perhaps even the controlling factor in price determinations.

However, he approves of the commission's August 2 order requiring the submission of detailed cost data. "I do not see how the area-rate proceedings can arrive at any useful conclusions without the cost data called for by the order," he told his audience in Houston.

Furthermore, he firmly believes that an area price must be a ceiling, not a floor.

"If every company insists that unless limited by contract it has the right to the area rate as a floor, plus anything more it can get in an individual determination, we may as well use an individual cost-of-service-rate-base method from the outset," he said.

At the same time, he would not permit a distributing company or some other intervenor to try to force an individual price down below an existing area price.

"The basic idea behind area pricing is uniformity of prices and administrative simplicity," Swidler pointed out in Houston. "If area proceedings are merely to determine rates which each individual company would be free to take or leave, we would accomplish very little. In fact, I would then view these cases as a giant step backward."

Swidler indicates that the only alternative to area pricing is the utility-type regulation. As he sees it, that approach would not be impossible, although it would be long and burdensome on all concerned. Moreover, he feels that it has the fundamental weakness of failing to provide stability for either the buyer or the seller because neither would know what the price would be until a case had been completed. By contrast, an area price gives each a definite figure.

Joseph C. Swidler
. . . pushes area pricing.

Small producers . . . Swidler hopes eventually to work out a system whereby small producers can be exempt from direct regulation.

He made no mention of this in his Houston speech, but he has indicated to a reporter that this will be given consideration.

One problem facing such an exemption would be determining where a cutoff line could be drawn legally.

But, Swidler said, "We would like to avoid putting the little fellows to the inconvenience and expense of participation" if they could be exempt without materially affecting the over-all effectiveness of the area-rate program.

Other targets . . . Swidler hopes the commission will be able to increase the general efficiency of the agency and thereby whittle away some of the enormous backlog of cases.

One of the immediate goals of the commission, Swidler said, is to take steps that would give FPC a "fighting chance" of deciding pipeline rate-increase cases within the 5-month suspension period. If this were done, it would eliminate the necessity for a pipeline to collect

Area Pricing

rates which are subject to refund.

An "ultimate" goal would be similar speedy action on producer rate cases. Swidler thinks this can be done once the ground rules for area-rate proceedings are established.

These are some of the steps Swidler has in mind to help achieve such goals:

... **Require companies** to prepare cases fully before filing for rate increase. That is, they would be expected to have all their evidence ready at the outset.

... **Streamline staff** field investigations. Apparently, Swidler would in many instances accept detailed data supplied by the company rather than requiring the staff to pore over company records in a full-scale field study.

"Through such cooperation, we can reduce the time which our representatives spent in your offices as well as the time between filing of a case and its final disposition," he explained.

... **Issue more** policy statements to clarify commission policy, thereby tending to reduce contested issues.

... **More pooling** of efforts by intervenors to avoid repetition and unnecessary dragging out of hearings.

Swidler hopes that one improvement will lead to another and that an increasing confidence in the commission by the public and by the courts, as well as by segments of the industry, will lessen the number of cases and the number of intervenors.

For example, he said, if the commission shows that it is doing a good job protecting the public interest, there would be little reason for state regulatory commissions to intervene in proceedings before the FPC.

He urged in Houston that all elements of the industry work together "to instill and maintain a justified sense of complete assurance in the adequacy and continuity of natural-gas supply, and at a price which will preserve its status as a fuel which is not only convenient and dependable, but inexpensive as well."

What Swidler Said About Area Pricing

HIGHLIGHTS of the speech made last week by Joseph C. Swidler, chairman of the Federal Power Commission, before a Houston meeting of the Independent Natural Gas Association of America:

"The area-rate proceedings will probably prove to be the most important single tool for developing a sound framework of producer rate regulation. They seem to me to be a promising administrative innovation which should be pushed forward with all dispatch and vigor."

▼ ▼ ▼

"From the consumers' point of view, the cost-plus formula which is applied to most utilities would deprive consumers of the benefits of the drive towards economy and efficiency which results when each producer reaps the reward for his efforts."

▼ ▼ ▼

"I believe that area prices, to be an effective form of regulation, must be set as ceilings and not as floors."

▼ ▼ ▼

"A continuing problem of regulation is to avoid needless uncertainty as to commission policies. Such uncertainties add to the caseload, stimulate litigation, and waste the time of everyone concerned. I hope that the commission can turn to the increasing use of policy statements to express commission policies in a clear-cut and comprehensive way, rather than waiting for policies to emerge fragment by fragment from a mass of decisions in long, drawn-out cases."

▼ ▼ ▼

"I am pledged to do what I can to simplify and expedite our rate investigations . . . We hope to have a fighting chance of deciding cases within the 5-month suspension period. That is our immediate goal as to pipeline cases and our ultimate goal as to producer cases once the initial area-rate cases provide the ground rules."

Reaction to Swidler is Mixed

FIVE HUNDRED gas men who packed the Shamrock Hilton's Continental room applauded when Joseph Swidler finished his speech on area pricing. Many stood in line to shake his hand.

Said one: "Since he spent most of his life with the TVA, I was expecting the worst. He surprised me."

INGAA President W. E. Mueller told Swidler he was encouraged by his "forthrightness."

But by banquet time, some enthusiasm has dwindled. With FPC members Jerome K. Kuykendall and Lawrence O'Connor seated at the head table, the INGAA passed a resolution giving FPC and its staff the back of its hand.

The resolution said the gas-pipeline industry's financial health is being "seriously endangered" by FPC actions and by recommendations of its staff which tend to cut earnings below levels required "for continued growth and expansion."

The resolution also reaffirmed INGAA's determination to "make every effort to obtain a fair and reasonable legislative and regulatory climate" for the entire gas industry.

Swidler had already left the meeting, but as news of his speech spread, it stirred comments all over the nation.

Said a major company spokesman: "Area pricing at this point is just a muddle.

"It appears Mr. Swidler has come to the commission with a closed mind. When he says an area price must be a ceiling, then you have to read into this statement that he is happy to adopt anything that can be

used to keep natural-gas prices low."

Said another: "I partially agree that area prices should be a ceiling. However, in unusual cases the producer should have the right to prove his case for a higher price.

"The area price ceiling will probably be hard to pierce—it should be, if it is to mean anything. But there should be room for a producer to obtain relief when there are extenuating circumstances."

Said still another: "The proposal to require complete filing of a case may be fine administratively to speed matters up. But it sounds like Jersey justice — anything to clear dockets."

In-place sales . . . Swidler lost many of his newly acquired admirers when he said in a press conference following his speech that he favors FPC regulation of in-place gas sales.

Swidler took the position that if the practice became the predominant method of acquiring gas supplies and FPC were excluded from jurisdiction, the effect would be "repeal of the Phillips decision" and loss of regulatory authority over the industry.

Shell Offers New Pricing Plan

SHELL OIL CO. wants FPC to chart an entirely new course to untangle the gas-regulation mess.

It is proposing that FPC:

. . . **Abandon** separate area-price hearings in favor of a single, nation-wide hearing. While area pricing should be retained, Shell thinks, FPC should first settle the issue of "gas prices vs. revenue requirements" on a national basis.

. . . **Accept** settlements of current price disputes and suspend new rate increases for a fixed period of perhaps 3 years. By then, FPC would have laid down a permanent policy or Congress would have passed new legislation to finally settle the issue.

The idea was first presented by Shell's general gas manager, W. B. Golush, before the Louisiana-Arkansas division of the Mid-Continent Oil and Gas Association. It was presented last week before the INGAA meeting by Oliver L. Stone, Shell's general attorney.

Both contended it is fallacious to study each supply area separately, since many companies operate in several areas.

Besides, said Golush, the whole U. S. picture should be studied first "to determine what levels of gas activity and producers' revenues are required in the public interest." This might take, he said, 3 to 5 years.

Because of the time involved, Golush suggested that "adversaries" in rate cases negotiate their differences, under FPC supervision, and maintain agreed-on prices for a certain period.

Stone told INGAA that a nationwide hearing could resolve the national issues, and then hearings could be held later to fix rates by areas.

FPC Chairman Joseph Swidler made no comment on the Shell plan in his formal INGAA address, but later told a press conference he would hesitate to "throw out the window" the "big investment" already made in area price hearings. He suggested Shell should make its proposal "through channels" directly to FPC.

Zwerdling Still Wants Prices Based on Cost

THE cost-of-service method of determining producer prices has been brought back into the natural gas regulatory picture by a Federal Power Commission examiner.

The examiner, Joseph Zwerdling, last week defended the approach, saying that a true cost of service figure would probably be below most existing field rates. In other words, most current prices are too high.

His views were given in a ruling on a major rate case involving Tidewater Oil Co. Zwerdling, using the utility-type procedure, concluded that Tidewater was not entitled to the 15 rate hikes it has been seeking.

In making his findings, Zwerdling took open issue with a commission opinion in the pattern-setting Phillips case last September. The commission at that time concluded that a company-by-company rate-base policy would in all probability result in higher consumer prices in most instances.

FPC has a choice . . . Since the membership of the commission has changed greatly since last fall's ruling, Zwerdling's opinion in the important Tidewater case will provide an opportunity for the present commission to express its views when it reviews the examiner's findings.

In effect, this sets the stage for a definite commission choice between a cost-of-service and an area-pricing approach.

In disagreeing with the "old" commission's opinion in the Phillips case, Zwerdling indicated that the commission had given too much weight to the company's application of cost of service and not enough emphasis to an "accurate" cost-of-service evaluation. Moreover, he said, Phillips was not typical because of the unusually large number of old contracts under which gas was still being delivered "at abnormally low prices."

Zwerdling said Tidewater's case "provides a more solid base for the consideration of the problems than was available when the FPC issued its Phillips opinion."

In applying cost of service to Tidewater, Zwerdling came up with a unit cost of 11.5 cents per thousand cubic feet.

Tidewater, also using a cost-of-service approach, arrived at a figure of 35.72 cents.

Zwerdling said the major differences between the price levels result mainly from treatment of income-tax allowances, rate of return, and the allocation of joint production-and-exploration costs between liquids and gas.

In allocating costs, he said, the choice is between use of a straight B.t.u. method and a "relative value" method.

He discards the former, saying it does not in any way measure comparative value of the two products.

Applying his "relative value" in the Tidewater case, Zwerdling allocated 5.9% of production costs and 24.17% of exploration costs

to natural gas. He indicated that the latter figure was liberal.

Tidewater, using the straight B.t.u. method, allocated 25.26% of joint-production expenses and 43.07% of joint-exploration costs to gas.

Zwerdling and Tidewater were equally far apart on a proper rate of return and on handling of taxes.

Tidewater asked for either actual taxes paid plus a 25% rate of return or a 12% return plus the benefits of the statutory tax allowances (including percentage depletion).

Ross Appointment To FPC Gets Fast Push From Senators

CHARLES R. ROSS of Vermont, President Kennedy's latest appointee to the Federal Power Commission, got speedy action by the Senate last week.

The Senate Interior Committee, in a quick, routine hearing, approved the nomination last Thursday and favorable Senate floor action was expected by week's end.

When Ross takes office, it will bring the commission to its full five-man strength, including three Democrats and two Republicans. Four of the members have been appointed by President Kennedy.

Ross, a Republican, will fill out the term of Frederick Stueck, who died July 15. The term expires June 22, 1964.

During the committee hearing last week, Ross said he felt the major problem facing the FPC was to reduce the backlog of cases. He indicated that the area-pricing approach and possible exemption of small producers were steps in that direction "certainly worth considering."

Ross, a 41-year-old attorney, has been serving as chairman of Vermont's Public Service Board.

Born in Vermont, he did his college undergraduate and graduate work at the University of Michigan. After graduation, he became an instructor in business law and government at Oregon State College. From 1949 to 1953 he was with the Derby Construction Co., Louisville, Ky.

He practiced law at Burlington, Vt., from 1954 to 1959.

Watching WASHINGTON

Clyde La Motte

• Oil industry has its successes, too, in Washington . . .

FROM TIME to time some people (including this publication) flail away at the industry for its failure to get a particular job done in Washington.

When such criticism is justified, it is entirely proper. By the same token, notice should be taken when a job is well done. Too often, perhaps, such work slips by unnoticed or is simply taken for granted.

For example, the Internal Revenue Service not long ago was on the very brink of changing the tax treatment of the ABC-type of oil transaction. This would have had a tremendous impact in the oil patch.

However, some industry representatives—including the IPAA, TIPRO and others—moved into action. As a result, the IRS first decided to provide a period for industry comment. Then, having received this comment, it next decided to resume issuing rulings on such transactions (see story p. 93).

IRS hasn't closed the book on the issue, but it seems apparent now that, aside from a closer scrutiny of each case, it will resume handling the transactions in much the same manner as in the past.

But it was a close squeak, have no doubt about that.

• Don't overlook what is happening to FAA's rig ruling . . .

THEN there is the matter of the Federal Aviation Agency and its original plan to require anyone building a structure 150 ft. high or more to notify the agency 30 days before the construction was to begin. And to file a second notice when the 150-ft. height was reached. This obviously would be burdensome to many drillers. But effective presentations by the American Petroleum Institute and the American Association of Oilwell Drilling Contractors have caused the FAA to do some reconsidering. As a result, rule modifications are in the works.

There are other examples, of course. Efforts by the API and others certainly helped in toning down the nature and scope of the grandiose fuels policy study proposed by the coal industry.

The National Oil Jobbers Council, too, has done some effective chores, such as getting overtime exemptions from wage-hour provisions for jobbers because of the seasonal nature of their work.

And the Petroleum Equipment Suppliers Association did an effective job earlier this year in convincing Commerce Department of the wisdom of permitting the Export-Import Bank to provide backing for loans to enable foreign companies and countries to buy U. S. equipment.

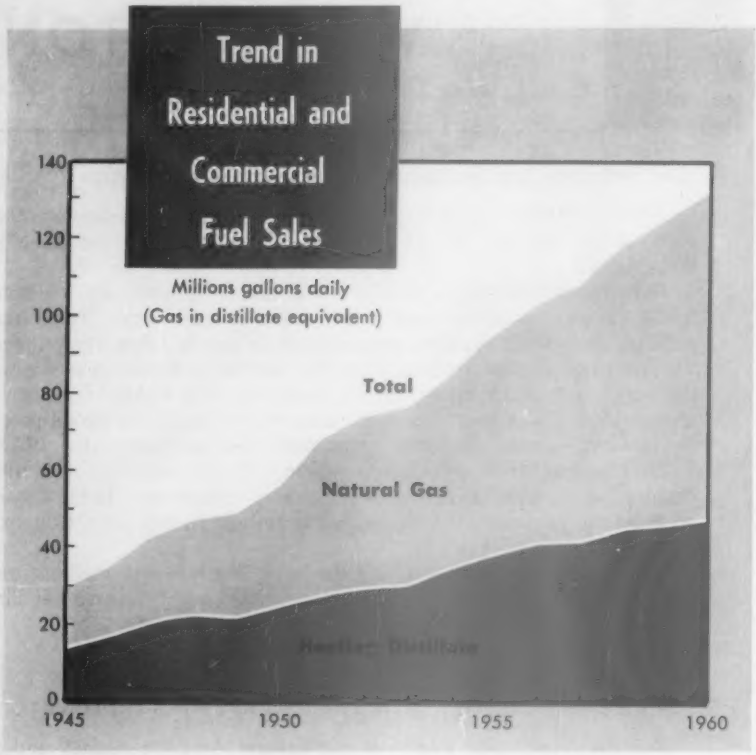
While none of these developments was earth-shaking, each was important to the people affected. Add them up and they mean a great deal to the industry.

Maybe critics of oil's representation in Washington should adopt the approach of a papa who, when asked how he handled his children so well explained: "I mostly whip 'em, but occasionally I give 'em a pat on the back."

• Mostly it's a matter of providing adequate information . . .

Believe it or not, a great majority of government officials are reasonable, fair-minded men. When they are given the full picture, they usually reach a logical conclusion.

So one of the industry's big duties is to keep everlastingly at the task of supplying them with the facts. It is not always a glamorous job, but it is a highly essential one.



Source: U. S. Bureau of Mines

How fuel sales compare in

(Thousand gallons daily—gas in distillate equivalent)

	1950 Distillate	1950 Nat. gas	1960 Distillate	1960 Nat. gas
District 1—				
Connecticut	995	.....	2,406	387
Delaware	120	.....	266	89
Dist. of Col.	229	185	283	348
Florida	124	22	273	270
Georgia	83	467	134	1,560
Maine	315	.....	612	.....
Maryland	823	227	1,112	990
Massachusetts	2,064	.....	5,337	1,116
New Hampshire	274	.....	450	44
New Jersey	2,471	72	4,421	1,726
New York	4,428	1,109	7,760	5,810
North Carolina	230	.....	981	248
Pennsylvania	1,839	2,690	3,773	5,821
Rhode Island	367	.....	778	170
South Carolina	76	.....	342	232
Vermont	98	.....	290	.....
Virginia	467	124	970	773
West Virginia	22	901	46	1,317
Total	15,025	5,797	30,234	20,901
District 2—				
Illinois	1,522	1,587	3,196	5,643
Indiana	539	438	1,855	1,940
Iowa	529	526	827	1,743
Kansas	97	1,320	74	2,316
Kentucky	70	681	121	1,641
Michigan	1,132	1,751	2,663	4,948
Minnesota	1,045	636	1,065	1,652
Missouri	433	1,249	650	2,905
Nebraska	233	571	206	1,240

Natural Gas Closing In on Heating Oil's Last Big

GAS is grabbing an increasing share of the market from distillates in fuel oil's last stronghold — the Atlantic Coast states from Florida to Maine.

In other regions, gas has dominated the residential heating and commercial fuel markets for more than a decade now—and in the last 10 years again increased its share of the business.

In spite of the predominant growth of natural gas, the distillates have shown a good growth in demand ever since World War II. The only trouble: The growth is nowhere as great as it would have been if natural gas weren't around to contest for customers.

The Northeast story . . . If present trends continue, natural gas will surpass heating oil in the Atlantic Coast markets in a few years.

In 1950, distillate-fuel rates there held a 3-to-1 edge over natural gas—15 million gallons daily for distillates against the equivalent of 5.8 million for gas.

During the past 10 years, however, demand for distillates in the coastal region doubled while natural gas demand nearly quadrupled. This left an edge for distillates in 1960 of only 3-to-2, or about 30.2 million gallons daily for distillates compared with the equivalent of 20.9 million gallons for natural gas.

Natural gas also made spectacular gains in other districts—especially in the Middle West, the nation's greatest fuel market. Gas enjoyed a 155% growth in demand there compared with a 100% growth for distillates.

Ohio, during the decade, moved up to challenge California as the nation's No. 1 gas-consuming state. California was easily No. 1 in 1950, but Ohio almost caught up. The 1960 statistics show California gas consumption was the equivalent of 9.5 million gallons of fuel oil. Ohio demand was 9.4 million.

Distillate sales for most regions just about doubled between 1950 and 1960. The exception was the West Coast, where distillate sales increased only 19% at a time when natural-gas sales more than doubled.

There were only 13 states in 1950 with no reported sales of natural gas for commercial and residential heating. By 1960 there were only 3 states with no sales, and this count included Hawaii which was not counted as a state in 1950. The only other states without gas were Maine and Vermont.

A look at demand . . . Distillate demand, taken as a whole, is nothing to belittle.

It's the trend of distillate-demand growth that concerns refiners and

he states and districts

	1950 Distil-late	1950 Nat. gas	1960 Distil-late	1960 Nat. gas
lorth Dakota	121	57	215	135
)hio	620	4,303	1,360	9,489
)klahoma	20	1,168	32	1,790
outh Dakota	121	109	190	301
ennessee	77	351	83	1,174
Visconsin	769	234	1,812	1,178
Total	7,328	14,981	14,349	38,095
District 3—				
Alabama	56	321	48	1,178
Arkansas	13	466	15	1,019
ouisiana	37	714	161	1,601
Aississippi	13	324	5	792
New Mexico	12	274	57	593
exas	135	2,416	218	4,674
Total	266	4,515	504	9,857
District 4—				
Colorado	75	674	110	1,632
daho	113		272	100
Aontana	76	410	103	582
Utah	60	209	97	661
Wyoming	30	197	20	277
Total	354	1,490	602	3,252
District 5—				
Alaska			182	4
Arizona	52	240	26	1,064
California	588	5,105	394	9,568
Hawaii			8	
Nevada	62		59	57
Oregon	619		680	199
Washington	1,130		1,486	293
Total	2,451	5,345	2,835	11,185
Total U. S.	25,424	32,128	48,524	83,290

U. S. Market

fuel-oil marketers. The percentage of growth is falling, and the growth nowhere matches that of natural gas.

From 1945 to 1950, distillates and natural gas expanded over the nation about the same rate. In 1950, distillate demand was 25.4 million gallons daily, and demand for natural gas was the equivalent of 32.1 million gallons.

Distillates enjoyed a 53.5% growth in the next 5 years, reaching a demand of 39 million gallons daily. Gas increased 73½% during the same period. Over the next 5 years, however, distillates made only a 24.3% gain in demand while natural gas enjoyed a gain of nearly 50%.

For the 10-year period, distillate demand increased 90.1% to 48.5 million gallons daily. Sales of natural gas shot up 150% to the equivalent of 83.2 million gallons.

Louisiana Defends Increase

. . . in production. Conservation chief claims state still doesn't get fair share of domestic market.

LOUISIANA is pulling out statistics to prove that its increase in production in the past 8 years is fully justified.

In fact, says James H. Gill, conservation commissioner, Louisiana is actually getting less than its fair share of the nation's market, despite "irresponsible accusations."

Gill presented his case at the annual meeting of the Louisiana-Arkansas Division of the Mid-Continent Oil and Gas Association in New Orleans.

During the period 1953 through 1960, says Gill, 76% of all new reserves added in the U. S. were credited to Louisiana.

At the beginning of 1953 Louisiana had 9.5% of the nation's reserves, and that year it produced 10.3% of the nation's crude. At the end of 1960, however, it held 15.1% of the reserves and that year had produced 14% of the nation's oil.

In other words, said Gill, Louisiana's share of the nation's reserves rose by 5.6% while its share of U. S. production rose by only 3.7%.

Gill also took issue with recent statistics given to the Texas Railroad Commission showing that "growth" states have been producing excessively at the expense of "decline" states. "Growth" states are those which increased reserves between 1956 and 1960.

Although it is true that the eight growth states increased production by 34% while their reserves rose by only 26%, Louisiana individually increased its reserves by 30% but its production by only 28%.

Dealer Survey Being Made

. . . by House subcommittee. Aim: To see if jobbers and station operators who lease facilities want to own them.

A HOUSE Small Business Subcommittee is bent on finding out whether jobbers and service-station operators who lease facilities would like to own them and, if so, whether they need loans in order to make the purchases.

It wants to know, too, whether major suppliers ever provide financing for such purchases by their outlets and, if they do, on what terms.

To get the information it feels is needed, the subcommittee is sending questionnaires to suppliers, jobbers, and retailers.

As part of the survey, the subcommittee is seeking to determine from suppliers how many stations they own, how many they operate, and how many outlets are operated on a commission or consignment basis.

Jobbers are being asked to list their suppliers and their retailers, together with information on whether they lease their facilities or own them and what financing, if any, they received from their supplier.

The dealers, in addition to being asked whether they could get financing to buy their stations if they wanted to, are being asked to list their suppliers by product and give details on their leasing arrangements.

After the subcommittee gets the replies to its questionnaires, it may hold hearings—perhaps a series of them.

It seems apparent that the subcommittee wants to set the stage for some action aimed at helping the service-station operators. A tip-off to this is in the letter drafted to accompany the questionnaire. In it, the subcommittee said that a study in 1957 had revealed the inability of some retailers and jobbers to obtain necessary working or equity capital.

The subcommittee is headed by Rep. James Roosevelt (D.-Calif.), who for years has charged that some suppliers "coerce" dealers.

Oil's Work Force Trimmed More Than Payrolls

MANPOWER-REDUCTION programs which have been in effect for several years are beginning to have an impact on company balance sheets.

Although a few companies have continued to make net additions to work forces, most are from 10 to 35% off their payroll peak, generally reached in the 1955-57 period.

Payrolls have not been reduced correspondingly. Reasons: Wage increases, the costs of large-scale layoffs, and the replacement of the less-skilled employe with the highly skilled worker or staff man. But employment costs are turning downward so that economies from this source are beginning to contribute to profits.

Automation made possible a sizable portion of the operating manpower cuts, although it also added to technical staffs. But the biggest share of the cuts apparently has resulted from consolidations, organization streamlining, elimination of levels of supervision, and belt tightening dictated by narrowing profit margins.

Here is how manpower has been cut in two industry divisions, according to the U. S. Bureau of Labor Statistics:

...In refining, total employment is 11% below the peak of 1953, and 4% below the 1947 level. Plant employes have been reduced more sharply, but additions elsewhere minimized the net employment loss.

...In oil and gas production, total employment is off 46% from the peak of 1957 and 26% below 1947. The field employes have decreased by a much smaller amount.

In the past 13 years, productivity has increased considerably. While refining manpower has been reduced 11%, refining capacity has increased by 87%. The average size of individual plants has more than doubled from 15,000 to 32,000 bbl. daily. Crude-oil production has risen 39% and natural-gas production is up 185%.

Refining trends . . . Manpower cuts are generally associated with the recession of 1958, but they were already well under way before the slump that followed the Suez crisis.

Total refining employment peaked 5 years prior to the 1958 slowdown, while the number of production workers in this industry division had leveled off immediately after World War II. The actual peak was 1951, when there were 143,000. But the plant-worker total was static for several years before a steady decline began in 1954.

About this time, refineries were being modernized. New larger units sometimes required fewer operating personnel than one of the multiple smaller units they replaced. New refineries were being built and manned with only a fraction of the workers employed in older refineries of the same capacity.

Independent refiners in particular were showing the way in operating successfully with less manpower.

Older refineries, which had grown by adding units over a period of years and which had accumulated big manpower pools to perform all services in the refinery, were at a competitive disadvantage. Several were losing money. Companies faced the alternative of cutting manpower or closing plants.

The result was a correction of the top-heavy manpower condition in a relatively short time because of the pressure of competition.

The sharpest drop in refinery plant workers occurred in 1958, when 7,000 were laid off. Last year this group numbered 26,000 fewer than in 1947. During the past 13 years, total refining employment has declined by only 7,000. Therefore, 19,000 of the plant-worker reductions have been cancelled by additions among staff functions.

Refining production workers last year constituted only 64% of the

What's Happened to Petroleum Jobs and Pay

in the postwar years	1947	1951	1955	1958	1960
Petroleum refining					
Total employes	189	199	201	192	182
Plant employes (both in thousands)	142	143	132	121	116
Average weekly plant payroll (millions $)	8.9	12.1	13.2	13.9	14.2
Petroleum, natural gas production					
Total employes	237	272	317	303	175
Field employes (both in thousands)	120	125	129	113	102
Average weekly field payroll (millions $)	7.1	10.0	12.2	12.4	11.7

SOURCE: Bureau of Labor Statistics

INDUSTRY

Russian gas experts, who plan a 4-week tour of the U. S., now are scheduled to arrive November 12 in New York. The 10-man delegation was expected September 3, but postponed the trip.

A uranium mill is being built in the Shirley basin area 60 miles south of Casper, Wyoming, by Petrotomics Co., owned by Tidewater Oil, Kerr-McGee, Skelly Oil, and Getty Oil. The 500-ton-per-day plant will cost $2 million.

Use of a mine tunnel in Nevada for natural-gas storage is being considered by Sierra Pacific Power Co. Sierra says the abandoned 4-mile Sutro tunnel, which once drained water from Comstock mines, might be used in connection with a proposed natural-gas pipeline from Las Vegas to Reno. This would be the

total payroll compared with 75% in 1947.

The average weekly payroll of refinery plant workers peaked at $14,400,000 in 1957, 6 years after this worker category reached its numerical high.

There was a 3.5% decline in 1958, the year of the big cut, but later wage increases more than offset the reductions in force.

Still, the payroll is 1% below the all-time high.

Oil and gas production . . . Although total employment in this division was at its highest in 1957, field employes were at their record level in 1953 and 1954.

Automation and the related centralization of production, collection, and treating facilities resulted in a gradual decline of field employes until a sizable cut of 5,000 was made in 1957 and 10,000 were laid off in 1958.

The 1960 level was 18,000, or 15% below the 1947 level, and 22% below the 1953-54 peak.

Total employes, meanwhile, experienced a drastic reduction of 42% last year, almost all of it in staff categories, according to the Bureau of Labor Statistics. In 1957, field employes made up only 38% of the total labor force, but last year they comprised 58%.

Pipeline Outlet Being Built

CONSTRUCTION will start immediately on a $2.5-million project to link northeastern British Columbia's Blueberry oil field with pipeline facilities at Taylor.

Authority to build the new line was granted to British Columbia Oil Transmission Co., Ltd., by the Canadian Government last week.

The line will consist of 11 miles of 4.5-in. gathering system and 66 miles of 8⅝-in. trunk line. It will carry crude and products from Blueberry field to the initiating station of Western Pacific Products and Crude Oil Pipelines, Ltd.

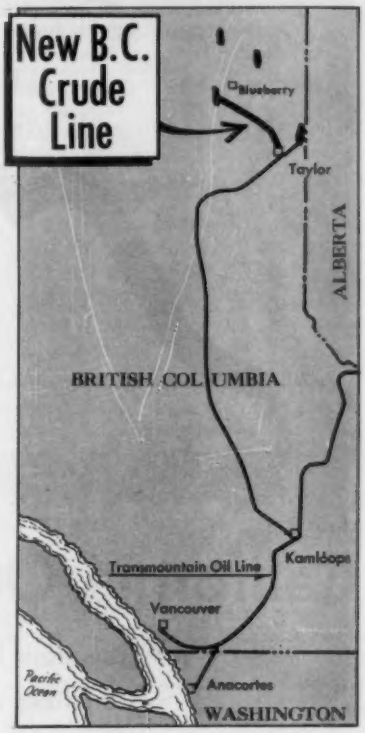
British Columbia Oil Transmission is jointly owned by Sun Oil Co., General American Oils, Ltd., and Western Natural Gas Co., Inc.

The Blueberry trunk line has been designed for a maximum throughput of about 14,000 bbl. daily.

Sun's announcement of the project said "the ultimate destination of the liquids handled will be the refining area in and around Vancouver, B. C."

Contract for building the line has been let to Pioneer Pipeline Contractors, Ltd., Calgary. Completion is scheduled for early December.

Western Pacific Products and Crude Oil Pipelines was set up under



sponsorship of Westcoast Transmission Co., Ltd., to build and operate a 505-mile, 12-in. line from Taylor to Kamloops, B. C. (OGJ, June 26, p. 128).

BRIEFS . . .

second such use of abandoned mining facilities. Gas is being stored in a coal mine in Colorado. (OGJ, May 30, 1960, p. 93).

Working interest in three oil wells on a 70-acre lease in Iatan North field, Howard County, Texas, has been purchased by Texas American Oil Corp, Developed primary and secondary reserves are estimated at 59,000 bbl., and there is spacing for four more wells on the tract. The company plans a water-flood in the near future.

Sinclair has bought six service stations and one unimproved location in Athens, Tex., from W. Bennett Smith, who was a consignee for Humble. Taking over as consignee for Sinclair is Parker Smith, Dallas.

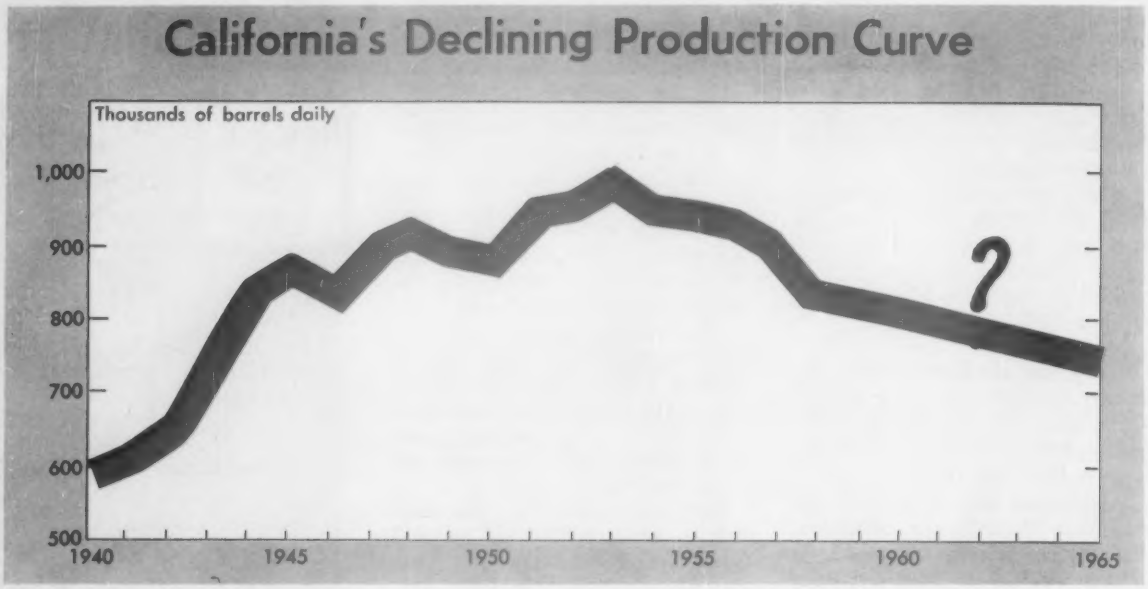
Officers of the organizing committee for the proposed Permian Basin Petroleum Association are Hamilton McRae, Midland attorney, chairman, Charles O. Ice, Monahans, Tex., oil operator, and James Watson, Midland, vice chairman.

October oil allowable in New Mexico will remain unchanged at 34 bbl. daily in southeastern fields and 70 bbl. daily for San Juan basin fields.

A blowby device made by the AC Spark Plug division of General Motors has been approved by California's Motor Vehicle Pollution Control Board. The blowby device cuts crankcase emission about 30%. Most new cars coming to California from Detroit are equipped with the devices, which cost about $6. One more device must be approved before they become mandatory on all California cars. The big problem still facing the board is approval of an exhaust control device. Eight afterburners have been submitted to the board, but approval is not expected until next year.

Cosden Petrochemical Corp. has been formed as a subsidiary of Cosden Petroleum Corp. to perform marketing advisory services. The new company is headquartered in New York City. Cosden's petrochemical sales in fiscal 1961 were $10.2 million and represented 12% of the total sales and 25% of Cosden's net income.

A gas well blew out last week in Latimer County, Oklahoma. It was Ambassador Oil's 1 James southwest of Wilburton. Blowout came at 8,982 ft. Early attempts were made to stop the flow with heavy mud.



California Output Still Shrinking

• The state hasn't seen a major-field discovery in 12 years and even normal-sized strikes are hard to come by. Stepouts also are coming in for less and less production. The outlook: A continued decline in production.

Carl J. Lawrence
West Coast Editor

CALIFORNIA, the nation's third-ranking crude producer, is on the down-hill side of a production curve and there is little hope it will ever pull out of the decline trend.

This doesn't mean California's production is going to drop out of sight in the next few years, but it does look as if production will never climb again. The rate of decline may level off some, but this is about the only sign of improvement expected.

Currently, the state's oil fields are making 812,900 bbl. daily. This is 17,800 bbl. a day less than the 1960 average. It looks as if the 1961 average will be about 815,000 bbl. daily, or 15,000 bbl. daily less than last year's average.

California's crude production has dropped annually since hitting a peak of 1,000,013 bbl. daily in 1953. Since then, output has fallen 169,277 bbl. daily, or an average of 24,183 bbl. per day each year.

One of the state's biggest crude producers is forecasting crude output at 815,000 bbl. daily for the next 3 years. The company expects production to edge upward to 820,000 bbl. daily in 1964 and to 825,000 bbl. daily in 1965.

Others don't buy these figures. They feel the decline will continue and never show an increase. The curve may flatten out in 3 or 4 years due to secondary recovery, but no increase is expected.

These estimates assume no major fields (100 million bbl. of reserves) will be discovered. It has been 12 years since California's last major field discovery—South Cuyama. A major discovery, of course, would upset all the forecasts, but even if a major strike were made today, it would take a year or 2 to build up enough production to turn the decline curve upward.

The "ifs" involved . . . You can make an argument on either side of the fence. But the arguments for a decline outweigh those for an increase.

It is generally agreed that two areas hold the most promise for boosting California's crude production. These are:

. . . Wilmington field, the state's biggest, with a daily production of about 75,000 bbl.

. . . The California tidelands. The offshore area is viewed as the most likely prospect for California's next major field. It is the only favorable area virtually undrilled. Some wildcatting has been done offshore, but only a fraction of the coastline has been tested.

The forecast calling for a production increase in 1964 is based on a sizable jump in production at Wilmington, where a big water flood is under way. The flood's primary aim is to stop subsidence in the Long Beach harbor area, but it also is expected to increase oil production.

Any increase in Wilmington's production will pretty well spell out what will happen to California's production in the next 3 or 4 years. Currently, injection is running about 435,000 bbl. daily and ultimately will hit near 1 million barrels daily.

Just this month an operating agreement in Block IV was signed which will clear the way for a full-scale flood in the field. In another year or 18 months, companies

should be able to plot Wilmington's flood behavior and get a good projection of future recovery rates.

Too, Wilmington's offshore area is still to be drilled. Reserves in the offshore part of the field are estimated at a billion barrels.

As one economist points out, a substantial increase in production as a result of the subsidence program, coupled with opening the tidelands to drilling, could bring a jump in production that might put California back in the million-barrels-a-day category.

But there's a major stumbling block in the way of opening the tidelands to drilling—and that's a municipal election. Long Beach residents aren't likely to approve a referendum permitting drilling in the tidelands until they are convinced the flood is curing subsidence in the present boundaries of the field.

Subsidence has been slowed down through the field and is expected to be arrested totally by July 1, 1963, but it's doubtful an election will be held any time soon.

"The oil is down there and there is a good chance you'll get some kind of additional recovery," one oil man says. "But people with only 2 ft. of freeboard aren't likely to rush out and vote for more drilling until they know the subsidence program is successful."

Politics also is mixed up in the offshore picture.

Some areas considered prize wildcatting territory are tied up by drilling bans. This is the case at the coastal cities of Hermosa Beach, Santa Monica, and Santa Barbara. These cities have been adamant in their opposition to drilling. A change in attitude in the near future is unlikely.

The only offshore acreage leased in the last 2 years has been eight tracts off Santa Barbara County and well away from the city of Santa Barbara. Drilling has produced two oil fields and two gas-distillate discoveries. These are in the early stages of development and won't contribute much toward taking up any slack in production until next year.

But virtually all California oil men believe it will be the offshore area that will produce most of the state's future oil discoveries.

Why the decline . . . Obviously, California's low discovery rate is the primary reason for the drop in production.

There are two other important factors:

. . . The normal decline rate in a California oil field is 15% annually. Once drilling in a field stops, the decline rate falls off even faster. California operators have to come up with 15% of the state's production each year in either extensions or new fields just to stay even. In recent years, the companies have not been able to make up this deficit.

. . . Today's stepout wells are not as good as those of the past. Historically, California operators could rely on getting 100-bbl. or better wells when they stepped out to a new location. This is not the case today.

Last year the average initial production of the 1,259 wells completed in the state was 79.8 bbl. daily. By comparison, the average the year before was 103.2 bbl. daily—and the average has been above 100 bbl. daily every year but four since 1944. The 1960 average is the lowest recorded in the state.

During the first 7 months of 1961, the average initial production rate was 72.3 bbl. daily—even lower than the 1960 figure.

Oil-well completions are up for the first 7 months of the year (683 vs. 604 during the same period last year), but the quality of the wells is down.

"We're just scratching a little nearer the bottom of the barrel," one oil man says. "And we'll be

California's Top Ten Oil Fields

NAME—	DISCOVERY DATE	PRODUCTION IN MILLION BBL. Peak (year)	1960*	Cumulative*
1. Wilmington	1936	50.8 (1951)	27.5	856.4
2. Ventura	1936	31.1 (1954)	17.1	622.8
3. Huntington Beach	1921	34.4 (1923)	16.5	650.9
4. Midway-Sunset	1901	50.0 (1914)	13.9	869.4
5. Coalinga East Extension	1939	24.7 (1944)	13.1	347.9
6. South Cuyama	1949	14.1 (1951)	12.2	127.0
7. San Ardo	1947	11.5 (1960)	11.5	90.7
8. Buena Vista	1912	16.6 (1948)	9.8	480.2
9. Coalinga	1887	19.5 (1912)	7.5	510.2
10. Kern River	1899	7.0 (1960)	7.0	349.7

*To 1-1-61.

THE LACK of a major discovery in recent years in California is obvious when you look at the top 10 fields in the state.

Last year's top 10 had an average age of 39.7 years, with the granddaddy being Coalinga, a field discovered in 1887. Another nineteenth-century field still among the top 10 is Kern River. In fact, Kern River was California's most active field last year as far as drilling was concerned. There were 243 oil wells completed in the field, just under 20% of the state total of 1,259.

The top 10 accounted for 44.8% of California's daily production in 1960, making 372,350 bbl. daily.

The California list probably will remain pretty much the same for years to come since secondary-recovery projects are under way or planned in all the fields.

Initial Flow of California Wells Is Down Sharply

Year	Initial Avg. Flow B/D	Year	Initial Avg. Flow B/D
1961*	72	1952	110
1960	80	1951	112
1959	103	1950	116
1958	107	1949	116
1957	97	1948	83
1956	93	1947	105
1955	109	1946	115
1954	102	1945	141
1953	114	1944	117

*First 7 months.

getting a little nearer the bottom all the time."

However, no one sells California's established fields short. Secondary-recovery projects are under way in several, and they are expected to be on production for many years to come. But most of the state's top 10 producing fields last year are past their peak (see table) and are on a declining production rate.

The drop in production in recent months has brought all the state's wells on production — other than those shut in to protect reservoir conditions. Shut-in capacity has run as high as 57,000 bbl. daily in 1958, but today output is near maximum.

A crude - price increase might scare up a little additional oil, but it's doubtful more than a few thousand barrels daily could be mustered.

Ironically, one of the nation's biggest fields, Elk Hills, is in California. But flow is restricted to less than 10% of its maximum since the field is in Naval Petroleum Reserve No. 1. The field has reserves estimated at 1,028,000,000 bbl. and a productive capacity of 175,000 bbl. daily, but production is held to 12,000 bbl. daily by the Navy.

District V future . . . The outlook for District V is much brighter than the California picture.

California accounts for 98% of the crude production in the district at present, but will lose percentage points as production continues to decline.

However, the district's future is not determined by "how goes California, so goes the district." Alaska is expected to fill the gap made by California's decline and keep District V production near the current total of 835,000 bbl. daily for the next few years.

Currently, Alaska is producing 20,500 bbl. daily from one field—Swanson River. Production from this field is increasing monthly and is expected to rise for months to come.

Too, there are vast areas of unexplored lands in the other District V states of Nevada, Oregon, Washington, and Arizona. Add these to the acreage still to be drilled in Alaska, and you have a lot of wildcat territory which should provide discoveries to offset California's decline.

Carla Cleanup Uncovers Oil

CARLA was a more deadly female than her victims suspected.

The oil industry along the Gulf Coast took its second look last week at the damage wrought by the massive waves of the swirling hurricane.

The reassessment: Damage to oil installations offshore will run to tens of millions—maybe $100 million. For those onshore, the cost will be millions more. The estimates include not only loss of equipment but loss of production and man hours of labor.

Offshore and inland water facilities suffered more than they did 4 years ago when Hurricane Audrey swept ashore in western Louisiana.

The reason was this: Carla hovered for days in the Gulf of Mexico, whipping up mountainous waves that pounded incessantly against platforms, barges, and flowlines. Operators blamed the waves, not the wind, for the bulk of the damage.

Costliest damage . . . Probably the most costly damage was to the facilities, not only because dozens—possibly hundreds—had to be repaired at considerable cost, but because of shutdowns in production and loss of labor time. Many offshore fields will still be on partial production this week.

Catwalks, stairways, navigational aids, and other outdoor equipment vulnerable to the destructive elements accounted for a large percentage of the damage.

A number of the rigs themselves suffered from Carla, and surveys of repair costs were still going on last week. At least half a dozen were headed for shipyard repairs, and at least one platform toppled over.

On shore the greatest loss to drillers by far was the downtime in drilling, rather than storm damage.

Continental Oil Co. was the only company which reported having an important structure in the gulf actually overturn during the storm. The accident occurred because pile driving was still in progress when the storm hit. The structure is a 4-pile platform in Block 108, Eugene Island area.

Single freak . . . The one real freak event of the storm was the 50-mile movement of Penrod Drilling Co.'s "Petrel," a mobile drilling barge, which floated from Block 198, Eugene Island area, to Block 162, Vermillion area. A company spokesman last week confirmed that earlier reports of catsup bottles and water glasses still standing on tables are true.

"There was no damage to the vessel, and it will be working again shortly," he said.

The only explanation Penrod had for the unusual incident is that the waves were sufficiently high to float the upper deck, which provided the buoyance to move the vessel along.

Other rigs . . . Southeastern Drilling

Carla Wasn't All Bad

It took Hurricane Carla to chop down the nation's refinery runs.

Refiners for the week ended September 15 charged an average of 7,241,000 bbl. daily of crude to stills, a decline of 1,231,000 bbl. daily from the week before. The total was the lowest since May of 1958.

But 1,137,000 of the decline occurred on the Texas Gulf Coast where Carla's winds and floods caused a string of plants to shut down for several days. Other refining regions showed very meager drops in crude runs.

PROCESSING

Expansion of an alkylation unit from 5,500 to 7,500 bbl. daily will be made by Atlantic Refining at its Philadelphia refinery. Catalytic Construction Co. has the contract for the rush job, which will start in mid-October and be completed within 5 weeks.

Ethylene-propylene rubber is being manufactured in commercial quantities at Humble's Baton Rouge plant for the first time. The rubber is made by coreacting ethylene and propylene gases in a process developed by Esso Research using polymerization catalysts licensed from Karl Zeigler of Germany. The new rubber reportedly has outstanding resistance to ozone, weathering, and

Damage Which May Total $100 Million

Co.'s Rig 22, in Ship Shoal 107, went to the J. Ray McDermott shipyard last week for a 2-or-3-week repair job costing several hundred thousand dollars. Water washed through the engine room and caused heavy damage.

Ocean Drilling and Exploration Co.'s "Mr. Charley," a submersible drilling barge, also went ashore for some $150,000 in repairs. Water washed into machinery and living compartments.

Louisiana Delta Offshore Corp. reported $500,000 damage to its No. 1 rig in the West Cameron area. It was headed for shipyard repair.

The California Co.'s underwater-storage unit, which broke loose and moved more than ½ mile, must undergo major repair. First assessments had indicated less serious damage. The unit had 15,000 bbl. of crude and 5,000 bbl. of sea water in it.

Processing plants . . . Carla handed the refineries and petrochemical plants of the Texas Gulf Coast a double job: Putting the plants in order and rehabilitating employes whose homes were swept away.

The rehabilitation job was actually the toughest. Companies in Texas City and Freeport, the hardest-hit cities, opened offices to help their workers repair homes. They offered tools, advice, and financial aid. First-aid rooms at the plants gave typhoid shots because of contaminated water.

Well-developed emergency procedures were followed during the storm, and these cut the property damage and prevented casualties, despite the 100 m.p.h. winds and 18-ft. tides.

Wind damage was superficial because plant design usually was for 125 m.p.h. winds. Insulation was blown off some process equipment and siding off some buildings. Some temporary buildings collapsed. Most of the plants suffered electrical failures. Dow Chemical Co. was completely out of operation for a week because of high water damage in both of its plants. Electric motors, control instruments, and switchgear were drowned in the water. The two plants should be fully on stream this week.

Dow arranged for rent-free apartments for employes whose homes were damaged or washed away. The company estimates damages at $2 million in unproductive labor costs and maintenance.

At Seadrift, slightly west of Carla's eye, the Union Carbide Chemicals Co. plant had only minor damage to roofing and building trim and was back in full production in less than a week after the storm.

Flooding was rough . . . At Texas City, three refineries and two petrochemical plants were hard hit by Carla's high seas. However, all but one are back on stream.

American Oil Co.'s pump house was flooded, but refinery units and buildings had only minor damage. About 120 employes and some families stayed in the plant throughout the storm.

Plymouth Oil Co. suffered freak damage from 150,000 empty oil drums which floated in from Texas City docks, where some 760,000 had been stored. The drums jammed against plant walls and units, and two of them found their way into the flooded office of the plant manager.

Monsanto Chemical Co. and Union Carbide Chemical escaped with only superficial damage.

Texas City Refining Co. had extensive water damage to instrument and electrical services and is still not operating. An inspection survey and equipment cleanup is in progress. The plant had 6 to 7 ft. of water.

None of the damaged refineries can expect to collect much insurance money. Insurance companies said policies do not give protection for high water—only for wind damage, which generally was slight.

BRIEFS . . .

chemicals. It is being offered for 26c per pound, f.o.b. plant, in carload lots.

"Catlocater" service to facilitate the purchase or sale by petroleum refineries of equilibrium fluid cracking catalyst has been started by W. R. Grace & Co.'s Davison Chemical Division.

Davison is starting a biweekly bulletin called the "Catlocater," which will list sources of the catalyst, and give types and quantities available.

Petrochemical plants worth more than $40 million are nearing completion at Odessa, Tex. The new facilities will produce ethylene and polyethylene plastics for El Paso Natural Gas Products Co. and Rexall Drug & Chemical Co. The ethylene plant will go on stream around the first of October, while the polyethylene unit is slated to go into production by December 1. A third unit, a $5.5 million benzene plant under construction by El Paso, already is in partial operation and should be operating at full capacity rate of 1,000 bbl. daily by September 1.

A gas-processing plant is being built by Banquete Gas Co., division of Crestmont Consolidated Corp., and Houston Natural Gas Production Co. in Goliad County, Texas. The $250,000 plant is designed to handle 10,000 M.c.f.d. of gas and extract 9,600 gal. of propane, butanes, and natural gasoline, using refrigerated lean-oil absorption process. The plant, first of five to be built by Crestmont, is situated on a main line of Houston Pipe Line Co. and should be completed in December.

Modifications of existing units to provide increased gasoline production are planned at Great Northern Oil Co.'s Pine Bend, Minn. refinery. Procon, Inc., has been awarded a contract to revamp the thermofor catalytic-cracking tower and add a second gas plant. These plans were brought about by a lessening demand for fuel oils and an increasing demand for gasoline, according to Great Northern.

TV Aids Ocean Completions

AN UNDERWATER television camera is helping a drilling crew working on ocean-floor completions off California.

The camera enables the crew to do work from aboard a drilling ship that normally would require a deep-sea diver. The camera takes a picture of ocean-floor conditions and relays it topside to a screen aboard the drilling ship, Global Marine Exploration Co.'s CUSS I.

Standard Oil Co. of California is using the TV approach on two wells it hopes to complete on the ocean floor off Santa Barbara County. The wells are 2½ miles offshore in water 235 ft. deep.

Using the camera saves time, since it can work around the clock. If a diver were used in water this deep, he could stay down only about 20 to 25 minutes before starting a 2-hour ride to the surface.

Photo shows camera being eased through drilling well of ship after use in completion work. Guide wires are used to direct camera to wellhead.

Texas Eastman Starts 275-Mile Propane Line

CONSTRUCTION of Texas Eastman Co.'s 275-mile 6-in. LPG line from Longview, Tex., to Sweeny, Tex., is under way and will be completed by the end of the year.

It will connect Phillips Petroleum Co.'s salt-dome propane storage facilities near Sweeny with the Texas Eastman plant near Longview. This is the seventh pipeline the Eastman Kodak Co. division has built to receive propane, ethane, and natural gas.

The Longview - Sweeny project will be built in three sections. The first two, totaling 207 miles, will be laid by O. R. Burden Construction Corp. A contract for the remaining 68 miles will be let soon.

FPC Splits Work on Gas, Power Cases in Speedup Maneuver

THE Federal Power Commission has made some organizational changes designed to separate its natural-gas regulatory work from its electric-power functions.

It has done this by setting up two new bureaus—one for natural gas and one for power—to replace the old Bureau of Rates and Gas Certificates, which had handled both.

The new Bureau of Natural Gas will deal solely with natural-gas, pipeline, and independent-producer rate filings and rate cases.

Three-Company Group High Bidder on Tract Off California Coast

A GROUP composed of Richfield Oil Corp., Signal Oil & Gas Co., and Mobil Oil Co. was apparent high bidder at the recent offshore lease sale conducted by the California Lands Commission.

The combine offered $2,101,875, or $495 an acre, for a 4,250-acre parcel off Santa Barbara County. Two other bids were submitted. Shell Oil Co. and Standard Oil Co. of California made a joint bid of $1,066,000 and Texaco Inc., bid $510,000.

Only one tract was offered.

The acreage is just east of Texaco's Carta Canyon block, which brought an all-time high bid for California of $23.5 million.

The apparent winning bidders are part of the STORM group made up of Signal, Tidewater Oil Co., Ohio Oil Co., Richfield, and Mobil. However, Tidewater and Ohio did not participate in the latest sale.

The commission is expected to approve the bid at its October 26 meeting. The lease will carry California's sliding scale royalty of 16⅔% to 50%, depending on the amount of production.

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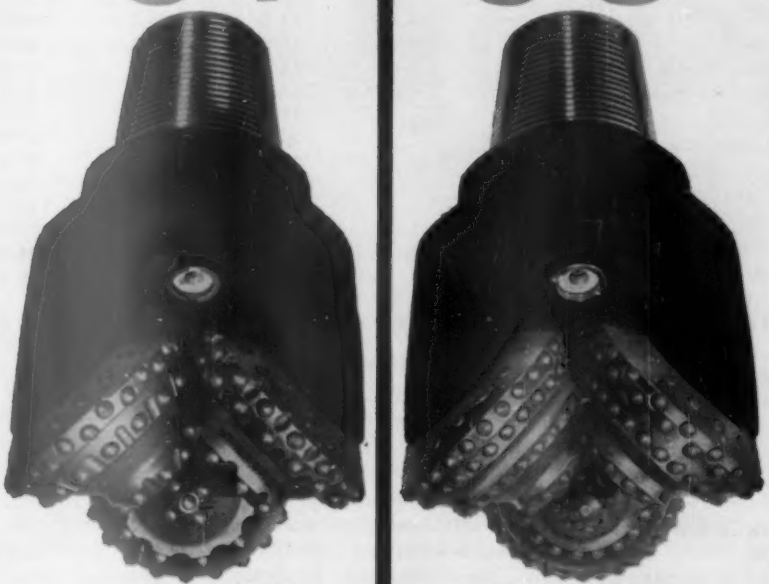

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Are "Flags of Convenience" On The Way Out?

• Union organizing drives make Pan-Lib-Hon tankers less popular. New orders are down, and transfers to European flags are becoming widespread.

LIBERIA remained the world's No. 1 tanker power in 1960 despite a sizable loss of registrations due to organizing drives by American unions.

But the United Kingdom replaced the United States as the second-ranking tanker nation, leaving the U. S. in a virtual tie with Norway for third. A continuation of the current trend of Liberian transfers, U. S. stagnation, and rapid growth of others could put either the U. K. or Norway on top by the end of this year.

Here is a summary of last year's changes:

... Liberia, down 6.3% from 794.3 to 744.8 T-2 equivalents.

... United Kingdom, up 5.4% from 555.6 to 585.6 T-2's.

... United States, up 2.1% from 563 to 575 T-2's.

... Norway, up 3.3% from 444.8 to 574.1 T-2's.

... Panama, down 6.1% from 244.8 to 229.8 T-2's,

This changing tanker picture is reviewed in Sun Oil Co.'s nineteenth annual survey, prepared by Dr. James S. Cross, manager of the economics department.

The world fleet at the end of 1960 consisted of 3,264 vessels of 67,780,400 dw. tons and equal to 4,076 T-2's. This was 12 fewer ships than the year before, but carrying capacity was up 6.5%. Ships that were old, small, and slow continued to be replaced by newer, larger, faster ones.

Pan-Lib-Hon fleets decline ... The Sun study and events since the period it covered indicate that the days of domination by so-called "flags of convenience" or "flags of necessity" are numbered.

The rise of operating costs in the United States since the end of World War II, when the U. S. dominated the seas, has led tanker owners to register ships in Panama and Liberia mainly, and also Honduras. Ships so registered benefit from lower taxes and crew-wage rates, which are only one-fourth the level on U. S.-flag vessels.

Where Tankers Are Registered

Flag of Registry	Tankers* in 1960	% Change to 1960 From 1959	% Change to 1960 From 1955	% of World 1960
Liberia	744.8	−6.3	184.8	18.3
United Kingdom	585.6	5.4	45.0	14.4
U. S.	575.0	2.1	15.6	14.1
Norway	574.1	3.3	55.5	14.1
Panama	229.8	−6.1	20.0	5.6
France	186.0	9.5	67.4	4.6
Italy	160.1	11.7	57.6	3.9
Sweden	151.5	7.4	85.2	3.7
Japan	146.7	14.3	141.3	3.6
Greece	130.3	223.3	894.7	3.2
Netherlands	118.3	8.1	54.8	2.9
Others	473.8	24.6	106.3	11.6
WORLD	4,076.0	6.5	70.0	100.0

*T-2 equivalents.

As the U. S. lost its leadership, the Pan-Lib-Hon tonnage grew to include 450 American-owned ships of all kinds totaling 11,000,000 dw. tons. These ships are pledged by treaty to U. S. defense control in case of emergency.

The U. S. was the big loser in this practice, but other traditional maritime powers and their seamen's unions resented it also. Their displeasure spilled over into a 2-week boycott of Pan-Lib-Hon ships on Dec. 4, 1958, by the International Transport Workers Federation. The federation invited American union help, and since then pressure has mounted.

It was climaxed this year when the National Labor Relations Board ruled that the Pan-Lib-Hon flags were fair organizing targets for American unions. U. S. labor law applied, NLRB said, if ships are engaged in U. S. commerce, regardless of ownership.

Unions struck June 15 to win bargaining rights from American owners of these ships, and two unions actually succeeded with a few companies. But the oil companies and most big independent tanker owners agreed only to a study of the issue.

Earlier this month, the American Committee for Flags of Necessity asked President Kennedy to take measures to bar American unions from these ships. The alternative, they said, was to drive them to European registry and thus away from U. S. control.

Tonnage losses heavy ... Last year, according to the Sun survey, transfers from Liberia totaled 91 T-2's, outnumbering transfers to Liberia by 73 T-2's. Deliveries to Liberian registry were only 40% of the 1959 level.

Most losses have been to the Greek flag.

Panama lost 16 T-2 equivalents.

A combing of Lloyd's Registry over the past 3 years indicates how widespread is the move away from "flag of convenience" registry. Since October 1, 1958, shortly before the union boycott, 385 ships totaling 3,510,109 gross tons have been transferred from the Liberian flag zone. About half were tankers.

The current Liberian tanker fleet is 384 ships of 7,071,300 gross tons or 11,420,200 dw. tons.

Of the total transferred, 84 ships of 722,230 gross tons were American owned, 87 ships of 963,427 gross tons were believed to be American owned, and 214 ships of

1,824,452 gross tons were owned by others. Because of complex corporate structures and multiple citizenship of some owners, nationality of ownership is often hard to establish.

New orders for the Pan-Lib-Hon flags are off sharply, and several ships originally destined for these ensigns will end up under European registry. Some U. S. owners are simply putting their ships up for sale rather than have their costs raised by paying U. S. union wage rates.

The most notable example this summer was the sale of Cities Service Co.'s 70,000-ton super tanker to a Dutch firm to fly the Dutch flag (OGJ, Sept. 4, p. 104).

Other tanker trends . . . Here are the highlights of other significant trends pointed up by the Sun study:

The average age of the world tanker fleet is now only 7 years and 4 months, almost a year younger than the average of the year before. The U. S. fleet is by far the oldest. About three-fifths of U. S. carrying capacity was built before 1946, mainly to fuel a war machine. Most of the Greek and Swedish fleets have been built since 1955.

New deliveries last year exceeded net new orders by more than 4,000,000 dw. tons. But orders are picking up.

Round Station Fits Triangle

A CIRCULAR design has been followed throughout in a new multipump service station which Standard Oil Co. of California has opened at Los Angeles' International airport.

By using the design, Socal is able to get the most out of the triangular lot shown in above photo.

A canopy 120 ft. in diameter covers the station. The canopy is supported by four tapered columns.

Beneath the canopy is an inner roof, 64 ft. in diameter. The station's office is located in one circular building and rest rooms in another. Both buildings are 21 ft. in diameter.

The station is designed for fast, heavy volume service. There are 18 gasoline pumps available from two of the three sides of the lot. The station operates 24 hours a day, employing 22 people.

Pipeline Briefs ...

Aminoil's new 33-mile 24-in. crude line from Wafra to Mina Abdulla in Kuwait has just been completed by Motherwell Bridge Contracting & Trading Co., Ltd.

A 21-mile, 4-in. natural-gas-liquids line will be built from the Hudson Gas & Oil plant, Port Acres, Tex., to connect with the Dixie Pipeline system. Service Pipe Line Co. will own and operate the system which, with one pump station, will have a capacity of 2,000 bbl. to 4,500 bbl. of propane per day. Dixie will meter the flow at the tie-in point. C. A. Kohler of Beaumont is surveying the route.

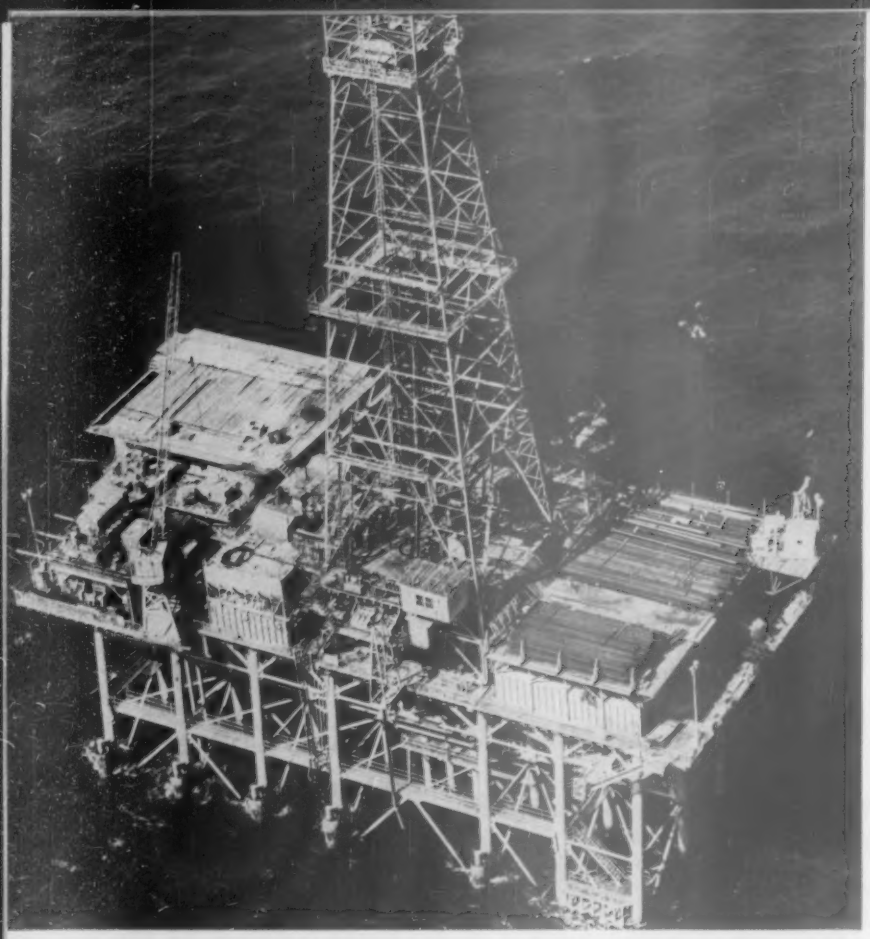
Nine miles of 16-in. line will be laid in Dekalb and Henry counties of Georgia by Atlanta Gas Light Co. Latex Construction Co. of Georgia is the contractor. Work began in mid-September.

Two projects are proposed by by United Gas Pipe Line Co. One is a 40-mile, 24-in. loop to its Mobile-Pensacola line and the other is 10.2 miles of 30-in. line in Terrebonne and Assumption parishes, Louisiana. The first will cost about $3.9 million and the second $1.9 million. Both are before FPC.

Deliveries by Interprovincial Pipe Line Co. set an all-time high of 434,549 bbl. per day in August compared to 352,429 bbl. in August a year ago. Last month's deliveries included 96,347 bbl. to western Canada, 97,736 bbl. to the U. S., and 240,466 bbl. to Ontario, including 4,452 bbl. via tanker. September deliveries are expected to average 416,707 bbl.

Pipeline expansion planned by Manufacturers Light & Heat includes 10½ miles of 24-in. to replace existing 16-in. line in Allegheny, Beaver, and Washington counties in Pennsylvania, and additional 4,000-hp. compressor capacity at a Marshall County, West Virginia, station. FPC has given temporary approval.

First tests in a new series on pipeline steel have been made near Athens, Ohio, by Battelle Memorial Institute for American Gas Association. The line was purposely damaged before laying to insure fracture under pressure. The speed and extent of the fracture are measured electronically.



Big Platform Goes to Work

DELAYED briefly by Hurricane Carla, Shell Oil Co. last week began operating a giant new 12-well drilling and production platform in Louisiana's West Delta Block 32 field.

J. Ray McDermott & Co. built the platform at its Bayou Boeuf yard at Morgan City and barged it to the 60-ft.-deep drilling site, 10 miles offshore.

McDermott made one of the heaviest lifts ever attempted in offshore gulf waters when the platform was erected. Two cranes with 250-ton capacity each set the 450-ton foundation jacket and, next to it, a 265-ton jacket. Three deck sections for housing, production, and drilling were then installed.

Shell will drill 12 development wells and run the crude to shore via gathering lines. The platform has no storage, thus cutting the fire danger.

The platform is 199 ft. by 82 ft. and rests on 28 piles 125 ft. tall.

Ramsey Takes Railroad Commission Seat

TEXAS' powerful Railroad Commission was at full strength again last week for the first time since Olin Culberson's death last June.

Ben Ramsey, bowing out as state lieutenant governor, was sworn in September 18 as the third member, joining E. O. Thompson and William J. Murray, Jr.

In a brief address Ramsey praised predecessor Culberson and colleagues Thompson and Murray and pledged his cooperation in pursuing constructive oil and gas regulatory policies. "There will be times," he added, "when we will not all see eye to eye. That is why we have a 3-man commission. But I assure you that I am a man who can object without being objectionable."

Texas Court Halts Enforcement of Rig Licensing Law

DRILLING and oil-well-servicing contractors won a temporary reprieve from a Texas Highway Commission order requiring registration and licensing of trailer-mounted rigs and servicing units.

A district court in Austin granted a temporary restraining order blocking the commission from enforcing its order on petition of several servicing contractors.

The court has scheduled further hearings on whether to continue the temporary restraining order and/or grant a permanent order for September 22 in Austin.

The commission ruling requiring licensing stemmed from what is termed a legislative oversight. Such rigs previously had been exempt from registration under a general clause in the statutes exempting "construction machinery" (OGJ, Sept. 4, p. 99). In amending the law during the past session, legislators inadvertently made this read "road construction machinery."

A contractor under past procedure paid a fee of $5 for an overweight permit when moving a trailer-mounted rig. Regular licensing would cost an estimated average of about $500 per unit.

Automation Study Scheduled at Big West Coast Plant

TIDEWATER Oil Co. will take a close look at ways to automate and modernize its 135,000-bbl. Avon refinery in the San Francisco area.

The company has awarded a contract to two companies—a computer firm and a refinery construction company—to study Avon's operations. These companies, along with Tidewater engineers, will study possible ways to streamline the refinery.

The two firms with the study contract are Information Systems, Inc., and C. F. Braun and Co., both of Los Angeles. Braun was contractor for Tidewater's big Delaware City refinery.

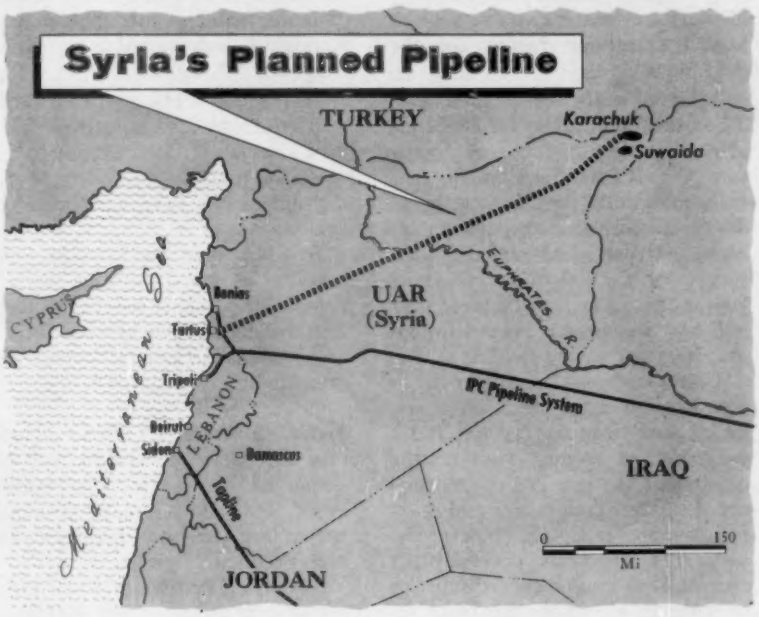
Syria Heads for Oil-Producer Status

• Pipeline to Mediterranean is scheduled to move 40,000 bbl. daily from two fields. Arab officials say reserves exceed 1 billion barrels.

SYRIA, now the northern region of the United Arab Republic and for years one of the "have-not" nations of the Arab oil world, is about to join the roster of the oil-producing nations of the Middle East.

Long one of the transit countries of the Middle East and on the tantalizing edge of the oil which flowed across its borders from both Iraq and Saudi Arabia, Syria now is bending every effort to become a producer in its own right. The country's General Petroleum Authority estimates that today the little country can boast of reserves of more than 1 billion barrels of oil. This optimistic estimate of the country's oil resources is made by officials in spite of the fact that Syria has never produced a commercial barrel.

If, as Syria expects, the country produces 40,000 bbl. daily by mid-1964, it will be the result of a capital expenditure of $37.5 million, a preempted American oil discovery, German exploration, and the use of not-too-satisfactory Russian drilling equipment.



Reasons for optimism . . . Last year Syria began a 5-year plan for oil development which is supposed to begin paying off with actual oil marketing by mid-1964 (OGJ, Jan. 16, p. 66). This is based on prospects for 40 producing wells at Karatchuk field and a 400-mile pipeline to move the oil to the Mediterranean coast. The country has already earmarked $5.5 million for development drilling to expand the field and another $25 million for construction of the pipeline outlet. In addition to Karatchuk, the Syrian authorities are counting heavily on additional production from the nearby Suwaida field, discovered and being developed by a German firm operating under a concession agreement.

Ironically, both fields are just about as far removed from commercial outlets as oil could be and still be within Syria's borders. Both are in the extreme northwestern region of the country in the narrow corridor which juts between Turkey and Iraq. But either, on a regular producing basis, would make Syria a net-oil exporter.

Karatchuk field . . . Syria's first commercial oil find was made nearly 6 years ago by J. W. Men Hall, Syrian-born Illinois independent operator who has exploration rights covering 770,000 acres in northwestern Syria. After the discovery, Atlantic Refining Co. and Portsmouth Steel became Men Hall's partners.

Atlantic Refining has never relinquished its claim to its interest in the field. An Atlantic official is now in the Cairo capital of the UAR trying to work it out so that the government will "either reimburse the company or give us back our property."

The present government of the unified UAR (both Egypt and Syria) claims it is not responsible for the actions of the previously independent Syria. Atlantic calls the whole affair "expropriation" and insists it will not allow the matter to end as it now stands.

In 1958, the concessions were cancelled and all property and equipment taken over by the UAR Government. The government claimed that Men Hall had failed to live up to his drilling commitments and had transferred an interest to the American partners without prior governmental approval.

After the Syrian General Petroleum Authority was formed in 1959, it took over the operation. It inherited four producing wells and two dry holes. Since that time Arab engineers and laborers, with Russian advisers, have drilled three additional wells—two of them producers. A tenth well is now drilling below 6,560 ft.

The initial Karatchuk wells were

good for 500 to 700 bbl. daily. But No. 8, which produces about 4,000 bbl. daily, is the Syrians' pride and joy.

The Karatchuk crude is a heavy, asphaltic oil averaging about 21° gravity. It is viscous and sour, with a 4% sulfur content. Distillation tests indicate it has 80% fuel-oil cut.

Based on field development so far, General Petroleum Authority officials estimate reserves of at least 840 million barrels for the field.

UAR officials are pleased with the results obtained so far at Karatchuk, but they are not so happy with the Russian equipment now being used in the development work. Syrian authorities signed an agreement last year which called for the supply of 30,000 tons of soviet equipment. So far, a little more than half that amount has been delivered and is in use in the field.

UAR engineers complain that the Russian equipment is heavy, bulky, and requires far too much manpower to operate. They say the equipment is delaying the normal speed of the development and making it more expensive than necessary. The engineers concede that the Russian equipment is superior to some in use in the Egyptian region of the UAR, but they say it is far inferior to similar drilling equipment available in other parts of the world.

Mohamed el-Rifai, director of the work at Karatchuk, says pipeline construction will begin late this year or in 1962 and the field should be in full production by mid-1964. In addition to the drilling and pipeline construction, plans call for three storage tanks—each with a 560,000-bbl. capacity and a 4,000-bbl. daily topping plant—at Qameshly near Karatchuk village. The refinery is meant to supply the agricultural fuel needs of the immediate area.

Suwaida field . . . The German company which accounted for Syria's second commercial oil field at Suwaida, south of Karatchuk and near the Iraq border, is Societe des Petroles Concordia.

This company, owned 80% by Deutsche Erdol and 10% each by Geberhardt & Koening - Deutsche Schaschtbau and Dea-Schliemann Mineraloeolgesellschaft, started exploring in Syria in 1956 on 49 separate tracts totaling 538 sq. miles. The company drilled eight dry holes, but has three potential producers at Suwaida.

The discovery tested at the rate of 600 bbl. daily from an interval below 5,600 ft. The second well was only good for about half of that production rate, while the third tested 3,300 bbl. daily. The crude, of much better quality than that at Karatchuk, is described as similar to Iraqi oil.

Just a few weeks ago, Concordia and Syria signed an agreement for a joint German-UAR enterprise to develop the find. Details for the working agreement have not been revealed.

In addition to the Suwaida wells brought in by Concordia, Syria's Petroleum Authority — using Russian drilling equipment—has drilled an additional six potential producers offsetting the Concordia field.

Syrian oil income . . . Syria regards the discovery of commercial oil within its borders as a historic event, but oil is already a major contributor to the country's national economy.

The Iraq Petroleum Co.'s pipeline system crosses about 400 miles of Syria, carrying oil from Kirkuk to the Syrian port of Banias and the Lebanese terminal at Tripoli. In the extreme southwestern corner of the country, Trans Arabian Pipeline Co. (Tapline) passes through about 65 miles of Syrian territory, moving Saudi Arabian oil from Dhahran to Sidon on the Lebanese coast.

Revenue from transit and loading fees from both pipeline systems is an important factor in the Syrian economy. These fees accounted for about 20% of the current annual budget of the country.

Syria's needs for domestic petroleum—her only energy source—are supplied from the 24,000-bbl.-daily refinery built at Homs under contract by a Czechoslovakian firm and opened just a year ago. Since inland demand is only about 14,000 bbl. daily at present, Syria is already a product exporter.

Syrian authorities expect to add $20 million a year to the national treasury from crude exports when the Karatchuk and Suwaida oil starts flowing through an export pipeline.

Crude Discounts

• Study shows nations get more from oil than producing firms.

PRODUCING operations, primarily in the Middle East, are carrying the load for oil companies which supply the Eastern Hemisphere with a cheap source of energy—usually at a refining and marketing loss.

This is a situation which can continue only so long as producing profits are big enough to balance refining and marketing losses and still keep oil companies going. Once the losses begin to overpower the producing profits, the companies are in real trouble. If this happens, consumers lose an energy source, and producing nations lose the income from oil which they now receive.

These are the prime conclusions of a new study of Eastern Hemisphere oil made by First National City Bank of New York's petroleum economist, Edward Symonds.

The study, which amplifies and brings up to date a similar look at the same oil region in 1959, will be welcomed by any western negotiators trying to convince an Arab nation that producing profits are not unreasonable. There are a number of western oil companies in just that position today.

Symonds says there's more to it than just adding up the profits based on the number of barrels produced.

"The richness of Middle East oil resources and the great promise of new finds in Africa do not mean that abnormally large profits can be had for the asking by oil companies with a stake in the area," he says.

"Companies that have recently entered the field are learning from hard experience that large reserves alone do not guarantee profits.

"Oil has to be marketed as well as produced, and profits must be calculated on the over-all operations."

Since the seven major international oil companies produced 83.3% of the Eastern Hemisphere's oil and refined 67.5% of its products, Symonds regards the 1960 financial figures of this group as representative. Based on these figures he finds:

and Low Product Prices Hurt Profits Abroad

Profits of Some International Industries

Comparison of 1960 after-tax return on total net assets of seven international oil companies and selected international companies in other industries.

	Net Assets (Millions)	Net Income (Millions)	% Return
Motor vehicles (7 companies)	9,523.3	1,549.5	16.3
Chemicals (8)	6,496.8	791.6	12.2
Electrical equipment (7)	4,887.2	593.3	12.1
Oil (7)	23,439.6	2,530.2	10.8
Rubber products (5)	2,074.6	221.9	10.7
Copper & copper products (7)	2,919.5	266.0	9.1
Paper & allied products (5)	1,983.9	181.0	9.1
Iron & steel (9)	7,958.4	685.4	8.6
Textiles (3)	917.0	72.4	7.9
Aluminum (5)	2,067.9	146.8	7.1

Source: First National City Bank, New York.

. . . **Oil profits** are not too high (see chart).

. . . **Production** furnishes the profits. By the somewhat simplified method of comparing company payments to governments and the estimated Eastern Hemisphere earnings of the 7 companies, Symonds finds that for the past 2 years the governments got $300 million a year more than the companies.

From this he concludes that what he calls the "downstream" operations of transportation, refining, and marketing were operated at a loss. He reasons that since the companies and the governments split producing profits 50-50, each would come out at the end of the year with an equal amount unless there was a company loss after the producing split is made.

Downstream operations necessary . . . The banking economist points out that even the most prolific oil well has no value unless it has access to profitable markets.

Reaching the market makes large capital expenditures in transportation, refining, and distribution necessary. With today's surplus of oil supplies, large-diameter pipelines, and big, cheap, and efficient tankers, the competition for these markets has become intense enough to make profits doubtful.

In the past, Symonds says, capital investment for refining and marketing facilities has been $1,500 per barrel daily of capacity in western Europe. The same figures for the rest of the Eastern Hemisphere may be twice that high because of low-volume, high-cost operations.

These capital investments are just as necessary to an oil company as investments made for producing, but they do not show the same return on investment.

Product prices in Europe have not kept pace with the increased capital costs. As an example, Symonds says petroleum-product prices have risen only 12% in Great Britain during the past 10 years in contrast to a general 50% increase in consumer prices generally.

Effect of discounts . . . The producing profits which the companies divide with Middle East governments are based on the posted prices of crude oil. One reason for decreased company profits is that all of them, to some extent, have been absorbing price discounts in order to sell their oil.

The New York economist estimates that at least 10% of Eastern Hemisphere oil, or 200 million barrels last year, was sold at a discount of 35 cents off posted prices.

"Although there will be much political pressure to maintain crude postings," Symonds says, "they face a period of considerable economic strain. Whether they hold or not, the practice of granting discounts off posted prices will continue . . ."

The economist believes that what he calls downstream operations—everything after oil production—will continue to show a poor return for oil companies until the oil surplus is soaked up by increased demand.

New Refinery Planned in West Africa

WEST AFRICA will have one and possibly two new refineries to operate on African oil processed for the African market.

The first plant, a 14,000-bbl.-daily refinery, will be built in Senegal by the French government, a French Senegalese bank and the six major companies who market in the country. The majors, Shell, Mobil, Esso, Texaco, British Petroleum, and Cie. Francaise de Petroles, are expected to have a 60% interest in the new refining company, Soc. Africaine de Raffinage.

The new plant, to go on stream in 1963, will process franc-zone crude produced at Gabon and the Congo, with some supplies possibly from the Sahara.

The French also have plans, not yet firm, for a refinery at Abidjan.

First Zelten-Crude Shipment Goes to England

THE FIRST shipment of Zelten crude—also the first oil shipped from Libya—left the still unfinished Esso Libya terminal at Port Brega last week bound for the Esso refinery in Fawley, England.

The 26,000-ton tanker, Esso Canterbury, was only partially filled by temporary loading lines because Esso's new mooring device is not yet in operation.

The crude shipment was described as one of several loads of Zelten crude that will be shipped to various European refineries for test runs before the Port Brega terminal goes into full operation.

Foreign Rig Activity Stays High

THERE was no letup in foreign drilling action with the coming of summer's dog days. A Journal survey showed 851 rotary rigs in operation early in September, compared with 825 a month earlier.

Further gains in the U. S., where the number of active outfits increased to 1,882, as well as in Canada, where there was a rise to 159, brought the free-world total to 2,892 rotaries.

	Sept. 1961	Mar. 1961	Oct. 1960
LATIN AMERICA			
Argentina	109	109	109
Bolivia	14	15	15
Brazil	67	38	39
British Honduras	1	1	...
Colombia	20	18	14
Chile	6	6	4
Costa Rica	...	...	1
Dominican Republic	1	1	1
Ecuador	7	7	3
Guatemala	1	...	...
Mexico	144	104	144
Panama	1	1	...
Peru	13	13	11
Trinidad	23	25	22
Venezuela	32	29	43
Total	439	367	406
MIDDLE EAST			
Bahrain	...	1	1
Iran	17	13	14
Iraq	7	6	11
Israel	4	4	4
Kuwait	3	4	3
Neutral Zone	5	5	5
Qatar	1	1	2
Saudi Arabia	3	4	3
South Arabia	3	3	2
Syria	2	2	2
Turkey	11	11	11
Total	56	54	58
WESTERN EUROPE			
Austria	9	9	9
France	31	27	30
West Germany	88	88	100
Greece	...	1	...
Italy	31	31	31
Netherlands	5	4	4
Spain	7	7	6
Switzerland	1	1	1
U. K.	2	2	4
Total	174	170	185
AFRICA			
Algeria	46	38	38
Angola	3	3	3
Egypt	18	18	13
Senegal	1	4	1
Gabon	2	2	6
Gambia	1	1	1
Ivory Coast	1	1	...
Libya	35	31	35
Mauritania	1	...	...
Middle Congo	...	1	1
Morocco	1	1	1
Nigeria	3	4	5
Spanish Sahara	1	1	1
Somalia	2	2	2
Kenya	...	1	...
Tunisia	2	1	1
Total	117	109	108
ASIA-PACIFIC			
Australia	5	4	4
British Borneo	2	2	2
Burma	4	3	3
Formosa	1	1	1
India	17	11	8
Indonesia	12	12	15
Japan	15	15	15
New Zealand	2	2	2
Pakistan	5	4	5
Philippines	1	1	3
Timor	1	1	1
Total	65	56	59
GRAND TOTAL	**851**	**756**	**816**

NOTE: Estimates are made where complete up-to-date reports are lacking.

Spain to Get New Petrochem Complex

LESS than a year after turning down petrochemical proposals by Jersey Standard and Royal Dutch-Shell, the Spanish Government has formally approved a refining-petrochemical complex to be built by a state company.

The official gazette has authorized construction of the complex at Puertollano, in South Central Spain, by Calvo Sotelo, a subsidiary of the state-owned INI. Bids have been asked on a $10-million 177-mile crude pipeline to supply the project.

Capacity of the planned refinery was not immediately disclosed. But INI officials originally were seeking permission to build a plant in the 20,000-bbl. class. This would supply markets in the immediate vicinity and supply feed stocks for petrochemical units designed to produce 45,000 tons of nitrogen and 90,000 tons of chemicals yearly.

The refinery concessions include the right to unlimited imports and a tax advantage for 15 years.

Gulf Bolivian Brings In Gas-Condensate Well Near Santa Cruz

BOLIVIAN Gulf Oil Co. last week completed its latest rank wildcat as a gas-condensate discovery 35 miles southeast of Santa Cruz.

The well, Rio Grande 1, made 9,000 M.c.f. of gas daily through a half-inch choke from 5,200 ft. with a flowing pressure of 1,475 psi. The company did not reveal the condensate volume.

The discovery was drilled on what T. A. Kirby, manager of Gulf's Western Hemisphere exploration, described as a large structure in the southern portion of a 1,200,000-acre block held by Gulf in the Santa Cruz area.

The company hopes additional wells on the flanks of the structure may find oil. Kirby said future wells will also test deeper formations, including one which is productive at Caranda.

Stanvac Starts Work on Malayan Refinery

STANDARD-VACUUM last week broke ground for a $17-million, 20,000-bbl. refinery at Port Dickson, near Kuala Lumpur, in the Federation of Malaya.

Facilities at the new refinery will include both atmospheric and vacuum pipestills, a catalytic reformer, catalytic desulfurization equipment for diesel-oil treating, and an asphalt plant.

the OIL AND GAS JOURNAL

ANNUAL PIPELINE NUMBER

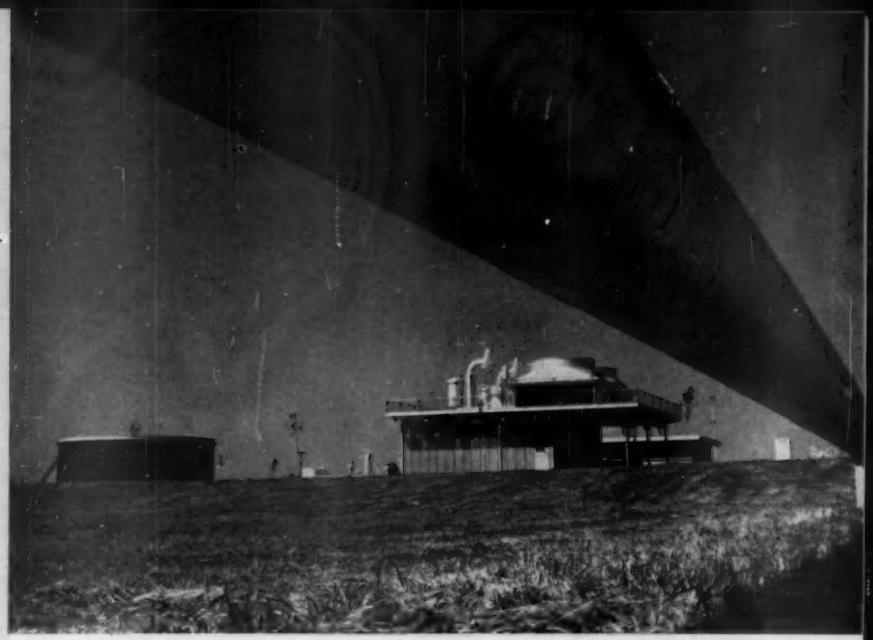
featuring . . . .

Plus

Columbium Steel May Be Answer to Need for Improved Line Pipe

Aviation-Type Turbine Delivers the Goods for Major Gas System

Construction Sidelights On 1961's Biggest Pipeline Project



MODERNIZATION of Service Pipe Line Co.'s 1,100-mile Fort Laramie, Wyo., to Whiting, Ind., system involved updating 18 stations, 13 of which will be remotely controlled. This is the Laton, Kans., station which houses three 2,000-hp. dual-fuel engines. Fig. 1.

UPDATING those older PIPELINE STATIONS

1. Crude oil and products lines

BY J. P. O'DONNELL
Assistant Pipeline Editor

PRACTICALLY ALL crude-oil and products pipelines are involved in pump-station modernization. But it is a thoroughly mixed-up picture.

For some companies, modernization is a system-wide operation. Others are modernizing on a piecemeal basis.

Some companies are just beginning to take steps others finished taking long ago. Yet, even some of the most advanced are only now adopting practices that one or two of the less-advanced picked up years before.

There are some procedures, now in limited use, that give every indication of becoming widely used. And there are other procedures that some companies find useful that others scorn. The first part of this article deals with more current developments. The second with older, less radical changes.

Coming changes. While it is a confused picture, one thing is clearly apparent. It was best expressed by the chief engineer of one of the country's major lines. He said:

"Although automation is extremely popular, the industry as a whole hasn't seen anything yet. Future progress will yield better, more reliable equipment with more emphasis on low maintenance requirements, interchangeability, and ease of interconnection. We predict that prepackaged, compatible components will be available in the next few years."

Here are some of the changes that are going on. Some are new to the companies that are doing them but relatively old to

others. Some are almost industry-wide in their acceptance, others have yet to be widely adopted.

Meters. Turbine meters are proving increasingly popular. Several companies are using them extensively, others are experimenting with them. The pipelines like their low-installation, low-maintenance costs. More metering, especially at incoming points, is being done.

Meter proving. The tank method is rapidly giving way to the piston prover. It's a quicker, in-line operation and, since it can be operated remotely, it is another automation attraction.

Controls. There are a multitude of controls in use. Ways are being sought to reduce the number, make them more meaningful. Unnecessary recording may be on the way out.

Interface detection. Its use is growing both on crude and products lines. The capacitance type seems to be preferred but presently more costly vibrating devices are being tried. A unit using cesium 137 is rated high for accuracy.

Power. Electrification is progressing with a common switch being from explosionproof to weather-protected motors because of lower cost. Dual-fuel engines are particularly useful where there are wide load fluctuations. Turbines may be in the offing.

Pumps. More companies are going to high-speed centrifugals. The fact that centrifugal pumps are easily controlled with a minimum of equipment makes them attractive in this era of automation.

Piping. Simplification is the keyword in piping and more is being installed aboveground for easy accessibility. The growing number of outside stations and more closed-system operation are important aids to simplification.

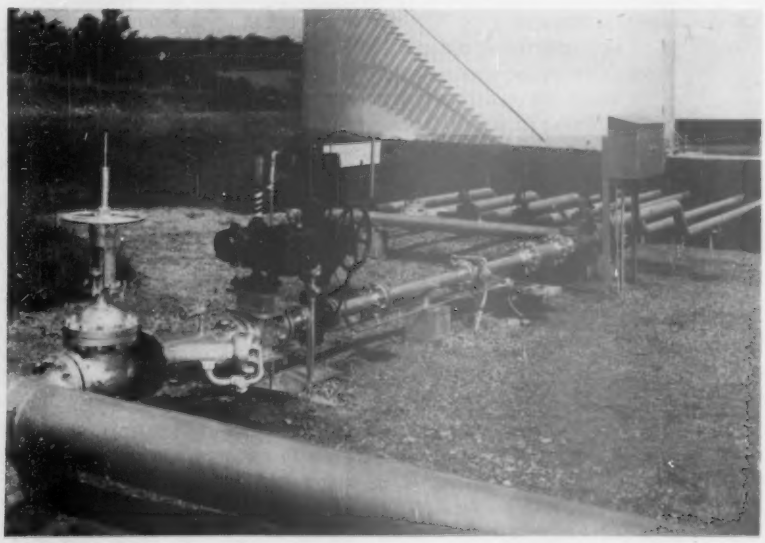
Structures. Buildings are being entirely eliminated or reduced in number. Those that are retained are special-purpose buildings, housing electrical and control gear. Some are prefab, all-metal, others are airtight, concrete block.

METERING—Mixed feelings found for turbine meters

TURBINE METERS are being used on a large scale by two pipelines and to a lesser degree by several others. The broadening extent of the present use of turbine meters and the experimentation going on by potential users indicate a growing acceptance of this device.

One of the companies using them extensively indicates that it has become its policy to replace positive-displacement meters with single turbine meters with sufficient capacity to measure the entire stream. One company that regards its use of turbine meters as still in the experimental stage finds them merely "acceptable" in performance but is enchanted with their low installation and maintenance costs.

Still a third major pipeline company finds them unsatisfactory from a maintenance standpoint. It has had trouble with bearings and turbine blades. The line is not equipped with strainers with the result that, as one engineer put it, the blades were literally "chewed up." Despite such experience, this company is going ahead with installing turbine meters for tank farm-dispatching purposes.



TURBINE METERS are used by Sarnia Products Pipe Line for local measurement and flow control and for remote metering of flow rate. Photo shows main line, gate and control valves, meter and tank manifold. Fig. 2.

Largest user. Probably the largest user of turbine meters is Plantation Pipe Line which has them installed at a number of stations. These meters range from 3 to 10 in. in size and are installed on lines ranging from 4 to 18 in.

One of the most attractive features of the turbine meter, particularly when high flow rates are involved, is its low installation costs. These are some reported round figures on relative costs of a 10,000-bbl. per hour metering system:

Turbine meter: Cost, under $6,000; installation, $5,000; total, under $11,000.

Single p.d. meter: Cost, over $25,000; installation, $5,000; total, over $30,000.

1,500 bbl./hour p.d. meter bank: Cost, $16,000; installation, $15,000; total, $31,000.

Good accuracy. Plantation credits the turbine meter with "excellent" accuracy and repeatability and regards it as a satisfactory instrument for measuring the volume of products. It is not infallible. The same precautions that would be taken with a positive-displacement meter should be observed with its turbine counterpart.

METER HEADS in Portland-Montreal Pipe Line System are connected with mechanical linkage so that throughput is added and recorded on separate meter head. This combinator can be read for dispatching reports for the entire bank. Fig. 3.

While a turbine meter will handle normal dirt without trouble, large objects that will not pass through the blades can damage the meter. Therefore, filters should be installed upstream to prevent this from occurring.

Other precautions include the use of straightening vanes in the upstream piping, straight pipe lengths upstream, at least 10 diameters, and downstream, at least 6 diameters, and flush lines to the pivots and bushings where abrasive pipeline rouge accumulates.

Counters can be located as much as 1,000 ft. from the meter. The remote-reading feature of the counters is one of the meter's inherent advantages. It also makes it possible to forecast batches readily by volume and volumes can be determined in 15 to 20 seconds.

Plantation has devised a cabinet for counters and, with a reference table and calculator, this has speeded up corrected volume computations.

Rate telemetered. Sarnia Products Pipe Line uses turbine meters in its unattended terminals. It chose the turbine meter since it could be used both for local measurement and flow control and for remote telemetering of flow rate. It provides an accurate flow-rate signal which is telemetered to the control center, 20 miles away, and also provides a signal for automatic control of the delivery rate and printout of total quantities.

Sarnia reported that the turbine meter's performance was most satisfactory and that it was considered completely operational. Fig. 2.

Cities Service Pipe Line Co. has installed a remote-metering setup at the gates of its Ponca City, Okla., refinery and, in doing so, has reduced a staff of 16 engaged in pumping and gaging to 1 man. Two 8-in. crude lines converge at the refinery, one from Guthrie, Okla., and the other from El Dorado, Kans. Fig. 3.

These lines pass through the metering station in parallel. Each is equipped with motor-operated valves and each has two 6-in. positive-displacement meters. The meter count is converted to pulses which are telemetered to the dispatching office in Bartlesville.

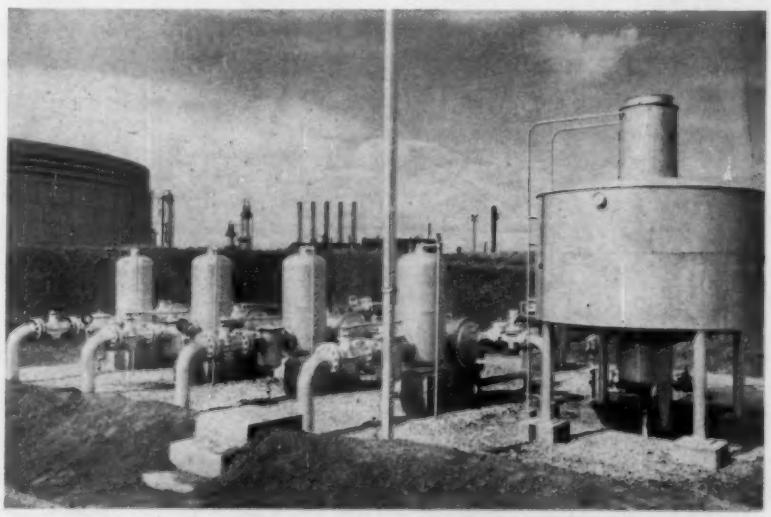
Each line is equipped with an explosionproof, automatic sampler and each has a record thermometer. The station also has a seraphin tank for volumetric meter proving.

Remote operation. Valves are normally operated from Bartlesville but can also be handled locally. If an upset occurs, a warning light lights up on the control panel in Bartlesville. Cities Service uses a Bell Telephone circuit. It is one of the companies that is abandoning its own lines for leased service.

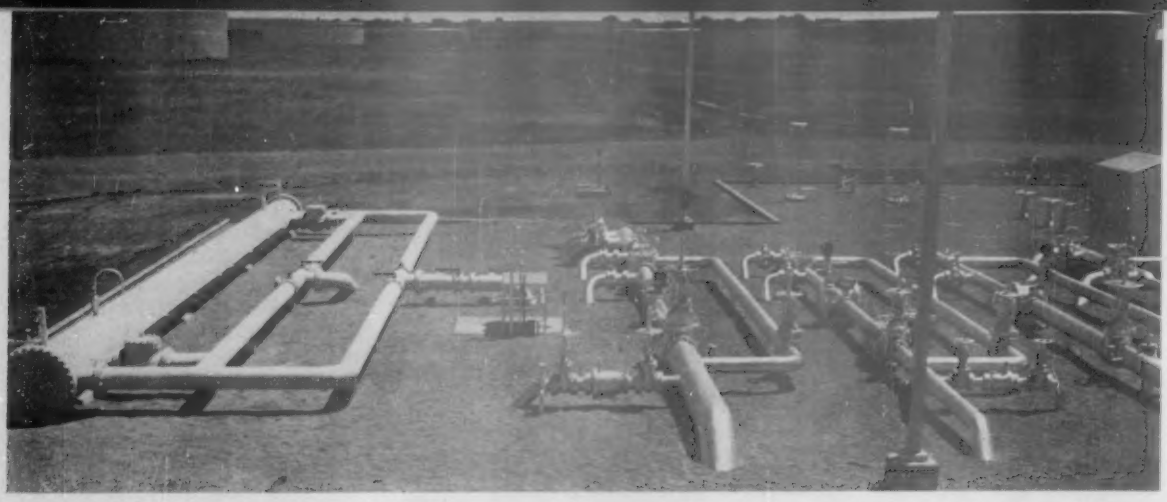
Now crude oil goes direct from the pipeline to the crude unit of the refinery instead of to intermediate storage. A surge tank has replaced the storage tanks. Gaging has been eliminated and valuable light ends conserved by this step.

Portland-Montreal Pipe Line System has a highly efficient metering system at its Montreal East terminal. It has two meter banks, one for each of two incoming lines. Meter heads in each bank are connected with a mechanical linkage so that the throughput of each is added and recorded on an additional meter head. The latter, or combinator, can be read for hourly dispatching reports for the entire bank. Fig. 4.

This station also uses automatic proving. It employs a two-cycle system filling and draining the prover tank. Both are controlled by capacitance probes which energize circuits to stop and start flows. Meters are calibrated after each major change in crude type. Automation of the proving operation saved time and helps to eliminate the human element and assure uniform calibrating techniques.



CRUDE OIL from two pipelines is metered at this Cities Service Pipe Line Co., Ponca City station and goes directly to processing units, bypassing storage tanks. Meters are read and valves controlled by dispatcher in Bartlesville. Fig. 4.



THIS BIDIRECTIONAL piston-type meter-calibration system calibrates two 8-in. turbine and two 6-in. p.d. meters at Comyn, Tex., station of Humble Pipe Line Co. The prover is 30-in. pipe, 48 ft. between detection points with capacity of more than 7,000 bbl. per hour. Fig. 5.

METER PROVING—Piston type increasingly popular

ONE CHANGE is being made on a broad basis in metering and another may be in the making. The change that is in progress is the increasingly widespread use of piston-type meter provers. The one that may be in the making is a growing use of turbine-type meters.

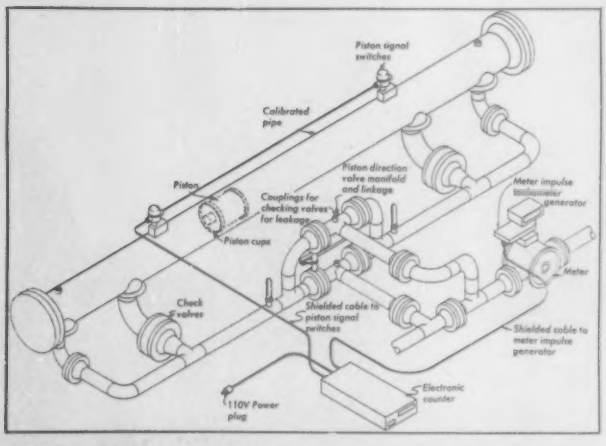
Quite a number of pipeline companies have adopted the piston prover, others are in the process of doing so, and still others are "considering" it. Few devices have developed such broad acceptance as fast as the piston prover. The reason is the great number of advantages it has over the volumetric tank method that has been common in the industry for years.

Possibly the main advantage of the piston prover is the ease with which it can prove a meter on stream. It is also accurate, fast, automatic, simple, and flexible.

Errors reduced. Since the meter remains in continuous service at its normal operating rate and pressure while it is being proved, there is less chance for error. Also, since the meter is in continuous service, errors resulting from starting or stopping are eliminated. The system has an accuracy of 0.02%. Because it is an on-line operation, the characteristics of the liquid being measured are much the same as those of the liquid in the line. Corrections for temperature can be more accurately used because the continuous flow through the system stabilizes the operating temperature of the prover.

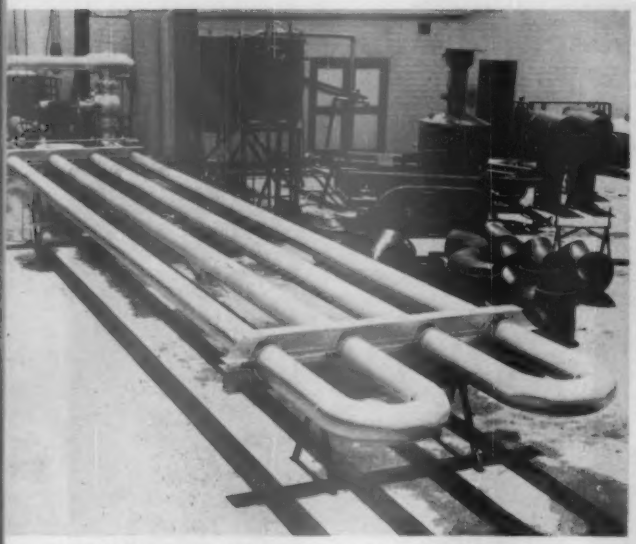
Another advantage is that a single prover, by adequate manifolding, can be made to serve a multimeter installation. It is an entirely closed system and can, therefore, prove meters at any rate or pressure. And it can do it fast. A complete calibration run can be made in less than a minute. Fig. 5.

Piston movers come in two types, bidirectional and unidirectional. In the former, the displacement device moves first in one direction through the prover section and then returns in the opposite direction. In the latter, the displacement device moves in the one direction through the prover section, is retrieved, and re-

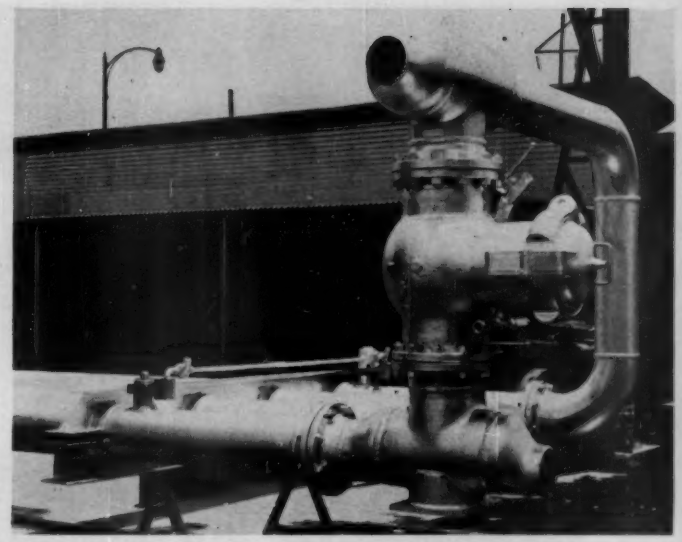


TYPICAL LAYOUT of bidirectional, straight-type piston prover system. By adequate manifolding it can be made to serve a multimeter installation. Complete calibration run can be made in less than 1 minute. Fig. 6.

BIDIRECTIONAL piston-type meter prover in process of installation at Wood River, Ill., station of Service Pipe Line Co. Insulation had yet to be added to unit. Fig. 7.



THIS UNIDIRECTIONAL version of the piston-type meter prover was scheduled for installation at Carthage, Tex., station of Texas Eastern Transmission Corp.'s Little Big Inch division. Fig. 8.



UNIDIRECTIONAL METER has a sphere retriever. The ball valve can be rotated to launch or retrieve a sphere and has quick-opening outlet chamber to remove or insert sphere. Fig. 9.

launched. An advantage credited to the former is the fact that any error encountered in a run in one direction is compensated for during the run in the opposite direction.

Many in use. It was just about 2 years ago that results of the first pipeline installation of a piston prover were disclosed. This was at Humble Pipe Line Co.'s Comyn station in North Texas. Since then more than 80 have been installed, quite a few others are on order and some companies have devised their own. A second company has gone into the manufacture of a piston prover.

In essence, the piston prover is the movement of a liquid-displacing device between detection points. When the plug trips the first detector an electronic relay is activated. Closing of the relay allows pulses generated by the tachometer to be tabulated on an electronic counter. The tachometer is geared to produce 100, 1,000, 10,000, or any desired number of parts. The counter records the pulses until the plug trips the second detector and the volume recorded on the counter is the metered volume between the detection points. Fig. 6.

Remote operation. The piston prover lends itself readily to remote operation. One company is now doing remote proving and another is in the process of setting up such an installation. A recently built system will employ several piston provers and will be able to prove meters remotely.

Metering of oil into pipelines is increasing steadily. One of the major systems reports that 75% of all the crude oil entering its lines is now metered.

A bidirectional piston prover in the process of installation at Service Pipe Line Co.'s Wood River station is shown in Fig. 7. This shows the prover before insulation was added.

A unidirectional meter is shown in Fig. 8. This unit is scheduled for use at the Carthage, Tex., station of Texas Eastern Transmission Corp.'s Little Big Inch division. The unidirectional meter prover has a sphere retriever shown in Fig. 9. The ball valve can be rotated to launch or retrieve the sphere and it has a quick-opening outlet chamber to remove or insert a sphere.

CONTROLS—Several trends appear in the making

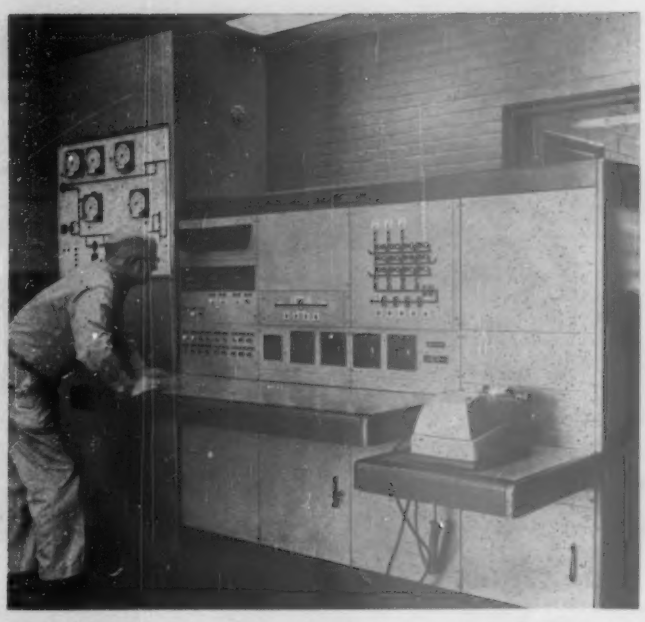
PIPELINERS are an individualistic lot and there is probably no place where this characteristic shows up more than in the control systems that are going into pump stations. Practices vary not only among companies but also within companies.

Pipeliners figure, and rightly so, that what is best for one system or one station is not necessarily the best for another system or another station. Too, they frequently improvise as a modernization program proceeds with the result that the last station to be updated might be quite different from the first. Figs. 10 and 11.

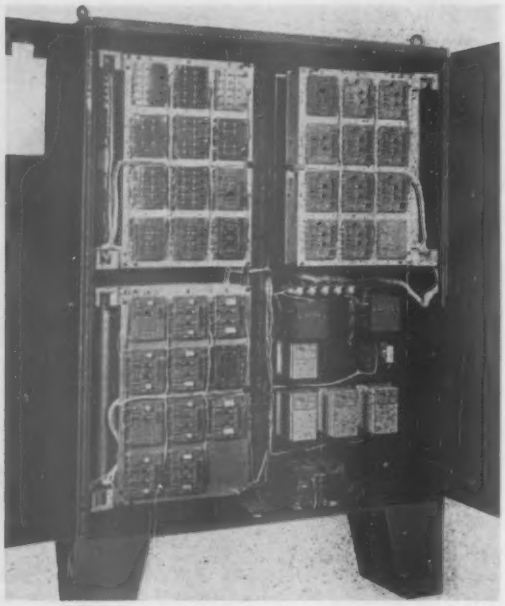
Out of the welter of functions that are now being performed by local or automatic control equipment, several trends appear to be in the making. A number of companies are assiduously looking for more comprehensive and more meaningful information.

A few are looking at record keeping on the theory that much of the information that is permanently recorded is unnecessary, time-consuming, and wasteful.

Solid-state equipment is supplanting vacuum-tube equipment in a number of instances.



DATALOGGER and graphic panel at Anchorage terminal of Interstate Oil Pipe Line Co. (now Humble). Pressures and tank gages are printed hourly and on demand, alarm and positions of valves and motors at subsidiary stations are displayed here but controlled locally. Fig. 10.

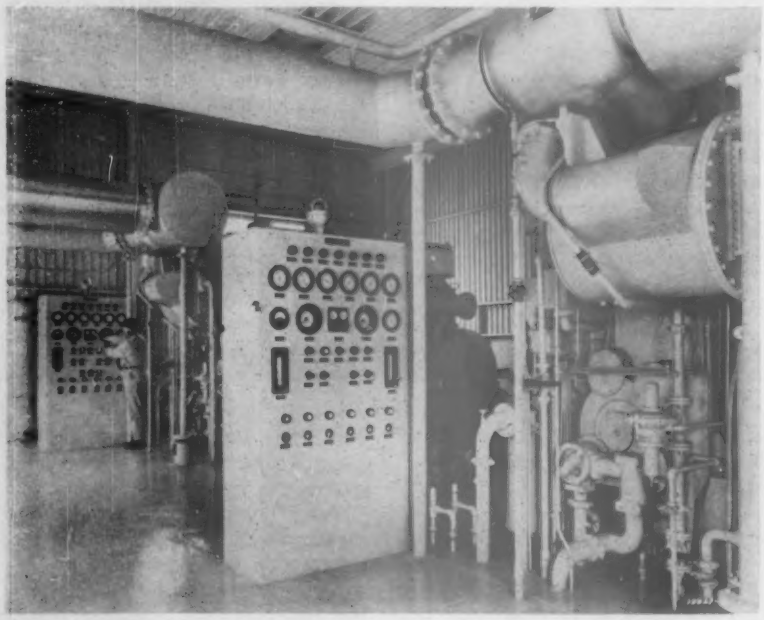


BECAUSE OF COMPACTNESS of components, control equipment on Cherokee Pipe Line Co.'s products system can be accommodated in enclosures occupying less than 5 sq. ft. of floor space both in master and slave stations. Fig. 12.

Meaningful data. A company that's looking for more meaningful information is now telemetering the throttle differential instead of both the case and discharge pressures. This has several advantages. In the first place, one pressure instead of two is telemetered. In the second place it gives the dispatcher the exact throttle pressure so that he can alter the rate to match. Finally it relieves the dispatcher of the need for calculating the throttle differential, thereby removing one area of potential error.

Another company is experimenting with a novel approach. Instead of recording suction and discharge pressures at each attended station it is trying out a single pressure point recording midway between stations. It hopes that it will cut down on data logging and provide more meaningful and quick results.

This device consists of a continuous recording orifice meter at the midpoint on the line. The company doing the experiment believes that this will lead to better pinpointing of trouble up or down the line.

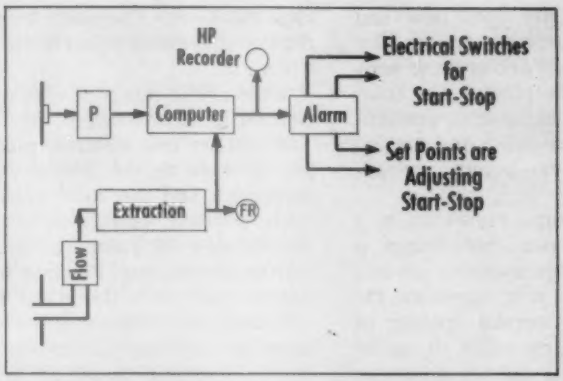


CONTROL PANEL in Sinclair Pipe Line Co.'s Teague, Tex., station. This makes possible one-man operation. Engines are equipped with pneumatically operated governors and speed can be controlled from engine-room panel or central control. Fig. 11.

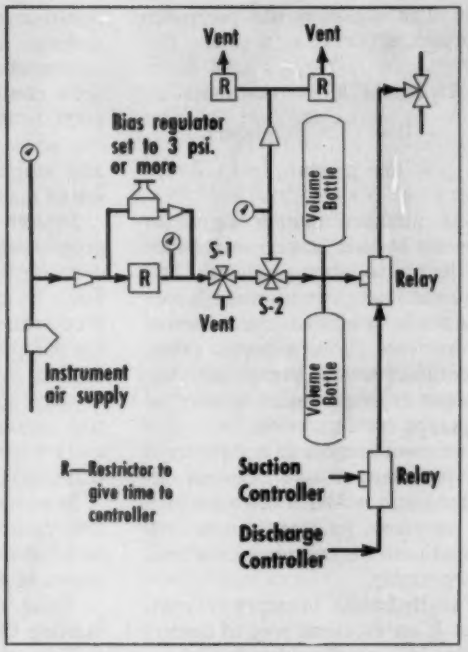
Alternate telemetering. Platte Pipe Line is in the process of adapting alternate telemetering throughout its system. Instead of using two transmitters, two circuits, and two receivers per pump station, it is alternately telemetering suction and outgoing line pressures over a single transmitter, circuit, and receiver.

There are several advantages to alternate telemetering. In using the single system, absolute calibration and chart-reading inaccuracies are canceled. The station differential pressure as read from the chart is more accurate than either the suction or outgoing line pressure.

Another advantage lies in the fact that the alternate trace actually shades the chart and pictorially presents a performance record to be compared with optimum conditions.



SCHEMATIC DIAGRAM of horsepower computer shows the main components. The computer has no communication link with other stations. Fig. 12a.



PNEUMATIC slow-start. The lowest signal is the only one felt on valve diaphragm. Fig. 12b.

The dispatcher can readily determine the pressure pattern and any change that may be under way. Excessive throttling at any station is both immediately evident and measurable.

The key to alternate telemetering is a repeat cycle timer with adjustable on-and-off cams. It controls a miniature three-way valve which first selects suction pressure, purges the instrument piping, and then selects the outgoing line pressure.

Less recording. One pipeline company is sharply cutting down on its recording and a few others are considering taking similar action. The company that is cutting down will do no more recording at stations unless there is a real need for it. It found itself accumulating and storing a lot of information that was never consulted.

Charts for a strip-chart record may cost from $2 to $3 and, though they are changed but once every 30 days, it does amount to something over a period of time. However, the principal saving lies in the fact that a man had to be at the station at the time the chart was to be changed. This was frequently inconvenient and, occasionally, resulted in the loss of hours of time.

Cherokee Pipe Line's products system from Oklahoma to Wood River was the first to use solid-state components throughout its supervisory control and telemetering system. It found the use of transistors and semiconductor diodes avoided some of the difficulties encountered with vacuum tubes, relays, stepping switches, and electromagnetic devices.

More reliable. Since transistors do not require heat for electron conduction they are less susceptible to sudden failure. Semiconductor components are infinitely smaller than tubes or relays. Because of the absence of heat and the compactness of the components, control equipment in both the master station and the slave stations can be accommodated in enclosures occupying less than 5 sq. ft. of floor space, Fig. 12.

Another company has gone in for solid-state components because of easier maintenance and greater reliability. This company finds that transistorized equipment is sensitive to heat. It is therefore installing its equipment in a windowless, concrete-block, air-conditioned building.

Automatic shutdown. One of the most progressive pipeline companies installs adequate monitoring devices to protect against damage to line pipe and local equipment. It does not, however, telemeter all of this information. If a damaging fault occurs, the pumping unit involved shuts itself off and reports that it is down. The station must be visited by a maintenance technician to determine the nature of the fault.

This company has reached the point where 64% of its pumping stations are under remote control, 57% are completely unattended, and 66% of its horsepower is controlled by either remote or local automatic equipment. It is shooting at the day when local automatic controls will be utilized fully and the control circuitry will be a simple computer with inherent logic capability.

Objective of another major crude-oil pipeline is eventual computer-controlled operation. This far-flung system envisions a master computer controlling slave computers for separate divisions of the system.

Station computer. A horsepower computer controls start-stop of prime movers at a remote, unattended pump station. The computer is self-sufficient and has no communication link with any other pump or control stations. The line's hydraulic conditions set the action of the computer. Fig. 12a.

The computer calculates hydraulic horsepower between the booster station where it is located and the terminal downstream of the booster. Input information is flow and pres-

sure. The equation the computer calculates is:

Hydraulic hp. = constant
× flow (bbl. per hour)
× line pressure (psi.)

The attended station upstream from the booster station establishes the hydraulic line gradient. The computer starts a pump when it sees an increase in hydraulic horsepower requirements above a preset value. It continues to start pumps until the horsepower requirement is met or all pumps are in service.

Optimum number of computers is one per line or one between attended stations. When there are two, the upstream station cannot tell which booster is operating or if both are operating.

The hydraulic horsepower computer is an excellent way to control cycling in a pipeline that has an injection point or points downstream of the main station. The horsepower equation combines both flow and pressure and prevents cycling that occurs when only one of these variables control the pump. The computer is electronic and in continuous service. Set points for starting and stopping the pumps are adjusted manually.

Smooth startup. Slow-start is a programing device that brings a centrifugal pump smoothly on the line. Its object is to duplicate the time taken for manual opening of the pump discharge valve. It can be tripped by a horsepower computer or other start-stop control. The control action is to insure a bumpless surge when the suction or discharge controllers take control. Fig. 12b.

Slow-start can start more than one pump. This one is pneumatic with electric solenoid valves but they can be all-electric.

These are the control steps for starting the first pump:

First, the control valve is closed. Solenoid valves S-1 and S-2 operate to vent the header pressure and close the valve. The relays transmit the lowest pressure signal to the control valve.

Second, the pump is started and brought to rated speed.

Third, the bias manifold places 3 psi. or more on the control valve's diaphragm and the valve begins to open. Pipeline liquids then circulate through the pump and prevent it from overheating. Pressure in the header rises above the initial 3 psi.

Fourth, the valve control switches from the slow-start header when the header pressure becomes greater than the lowest pressure from either the suction or discharge controllers. The pressure in the slow-start header increases to 15 psi.

Starting a second pump differs only in the first step. The control valve is closed a predetermined amount by the solenoid valve. The slow-start valve is not bled completely to atmospheric pressure. The first pump continues operating and the second is started and placed on line the same way as the first.

INTERFACE DETECTION—On threshold of change?

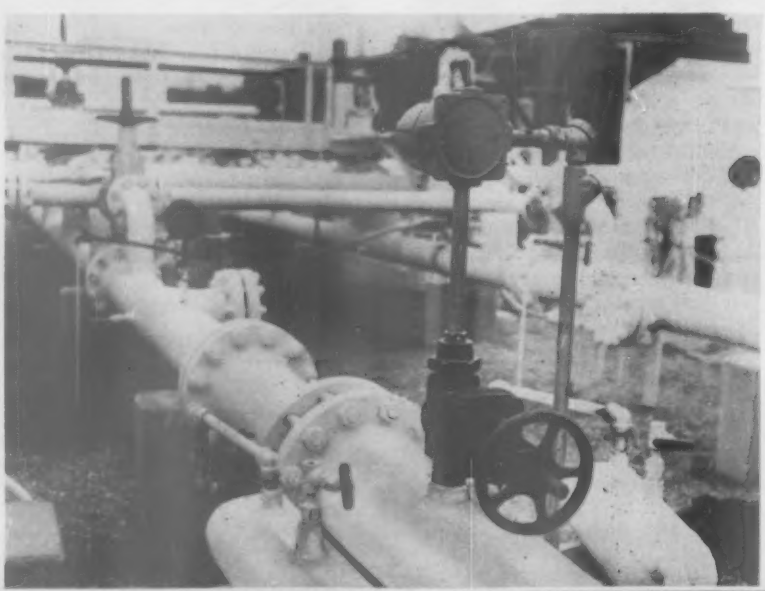
METHODS for detecting interfaces may be on the threshold of a change. Despite the fact that it is not generally a critical problem on crude lines where the effects of commingling are less serious, more attention is being paid to interface detection on crude lines as well as on product lines.

Capacitance - type detectors have come increasingly into vogue. A number of companies find them satisfactory but others say they have t r o u b l e keeping them calibrated properly. They do have one advantage over less commonly used types and that is cost.

One pipeline uses capacitance probes in "sets," one close to the station and one some distance removed. These sets cost approximately $3,000 whereas a single unit of one of the more advanced and possibly more r e l i a b l e type are priced around $5,500. The more distant detector warns of the approach of an iinterface and the one at the station announces its arrival. Fig. 13.

Others in offing. While the capacitance detector is apparently the preferred instrument at the moment, other types are coming into the picture.

Humble Pipe Line Co. recently modernized its 40-year-old Satsuma, Tex., station and, in doing so, installed vibrating paddle-type detector systems. They are said to be very reliable and can detect a difference of 0.3° API gravity. Their

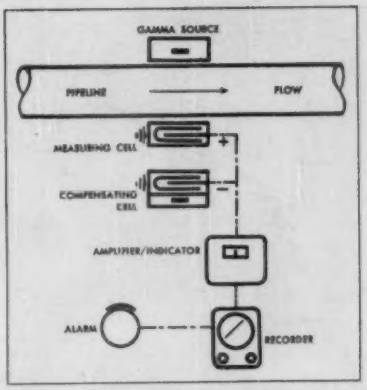


THIS PROBE is inserted into the line at the station to indicate the arrival of an interface. The measuring instrument is located in the control room, some distance away. Fig. 13.

output is read on a 0-1-ma. recording voltmeter on the station control panel.

Another major crude-oil pipeline will install a vibrating-reed-type detecting device in its system. This device employs two reeds, one with induced vibration. The viscosity of the product alters the vibration. This company's experience with capacitance-type detectors has been unfavorable and it is going to the vibrating reed device in the belief that it will stay in calibration.

At least one company is using a detector which employs the isotope cesium 137 as its source of radioactivity, Fig. 14. In this system, a radiation source is placed on one side of the line and a detection cell on the opposite side. Radiation passes through the pipe and the liquid flowing through it.



SCHEMATIC DIAGRAM of an interface detector which uses gamma rays produced by cesium 137. One pipeline company has several of these in use and rates them highly for accuracy and reliability. Fig. 14.

Used on loops. A certain amount of the radiation, related to the solids in the liquid, reaches the detection cell where it is converted to electrical energy, for transmission through an amplifier/indicator to a recorder. A direct measure of the specific gravity of the liquid is obtained.

Phillips Pipe Line Co. has a number of partial loops on its products lines. This posed the problem of regulating the interfaces in the loop and in the mainline so that both would arrive at the end of the loop at the same time.

It was solved by installing interface detectors at the same point in both lines, about halfway along the loop. The arrival of the interfaces is telemetered back to the station where the valve on one line is regulated to increase or decrease the flow to adjust for any difference in the interfaces.

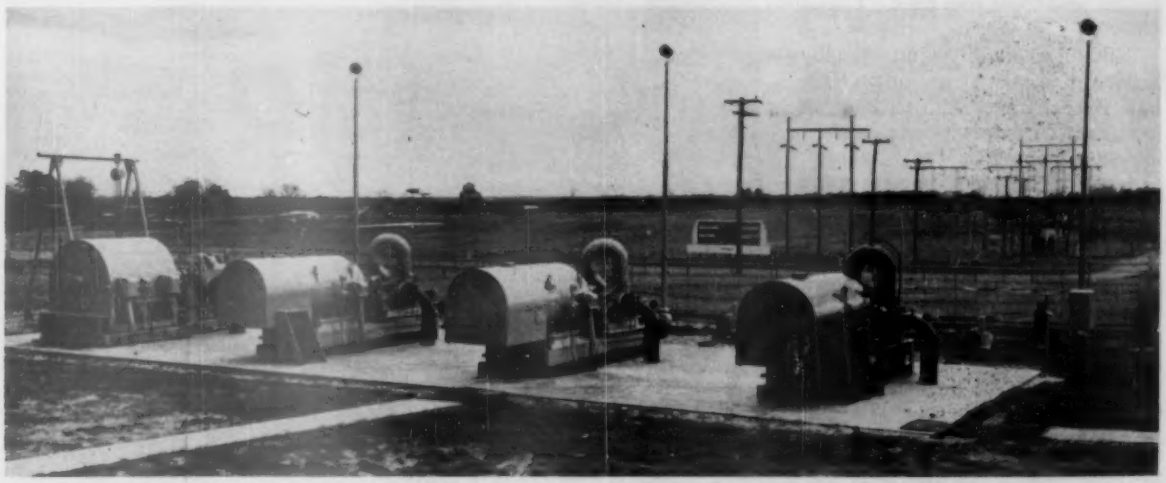
POWER—"Outdoor" installations in wider use

THERE ARE CHANGES going on in the area of prime movers in oil pipeline stations and others are apparently in the making. Electrification of pump stations is anything but new, but there is a switch under way.

This is the change from indoor explosionproof to outdoor weatherproof motors. Several pipelines have made this change in recent years and others are in the process of doing so. The increasingly widespread practice of eliminating most, if not all, buildings at stations has contributed much to the move to weatherproof gear.

Since explosionproof equipment is designed to contain explosions, it is high in cost. Weatherproof equipment with a limited amount of shielding to protect it against the elements and provide for changes in the direction of airflow is much less costly. The much lower first cost is the biggest factor in the replacing of explosionproof with weatherprotected motors. Fig. 15.

Turbines in use. Another change that may be in the making is an increased use of turbines on oil lines. Great Lakes Pipe Line installed a turbine at its West Tulsa station several years ago and was the first oil pipeline to use a turbine as a prime mover. It was not until last



INDOOR EXPLOSIONPROOF MOTORS were adapted by Interstate Oil Pipe Line Co., now Humble, to outdoor service by fitting them with protective hoods. These are the three 600-hp. motors, uprated to 850-hp., next to a 1,500-hp motor. Fig. 15.

MODERNIZING of the Fort Laramie-Whiting system was an all-inclusive job for Service Pipe Line Co. All 18 stations, 13 of them electric, were involved. All but the five batching stations will be remotely controlled. Fig. 16.

year that the second was installed.

Okan Pipeline installed the second at its Goltry, Okla., station in 1960, as a replacement. This 1,100-hp. unit operates at 20,000 r.p.m. and drives a centrifugal pump, through speed reducers, at 6,000 r.p.m. The gas turbine increased the capacity from 10,500 bbl. per day to 15,000.

Several other pipeline companies have bought gas turbines and still others are considering their use. One of the former is Phillips which has bought one unit to be used on a standby basis.

Turbine advantages. Phillips sees several possible advantages in the turbine. These include its low maintenance, the fact that it's self-supporting, that is, it needs no auxiliary equipment, protective devices and sequencing are integrated into the unit and, being skid-mounted, it can be changed from one station to another.

This turbine will go into standby service at an existing station on Phillips' Borger-Chicago line. It is an unattended station with remote stop-and-start controls. The 1,200-hp. turbine, with pump, weighs only 3,000 lb.

The purchase of several gas turbines by different pipeline companies and the increased interest shown by others may portend their eventual widespread adoption. This possibility is enhanced by the fact that smaller units are now available, thus widening their potential use by pipelines.

System updated. While the gas turbine may be in the offing, the big change in pump stations continues to be electrification. A good example of its extent is the modernization of Service Pipe Line Co.'s 1,100-mile Fort Laramie, Wyo., to Whiting, Ind., line. Fig. 16.

Service is in the last stages of modernizing this system now. When it is completed there will be 18 stations between Fort Laramie and Whiting, 5 batching stations and 13 remotely controlled, unattended stations. Eleven of the unattended stations will be electric and two will have dual-fuel engines.

The stations that eventually will be unattended were equipped with large, slow-speed diesels. Each station, with its attendant tankage, needed a crew of 20 men. Electrification and adapting the line to a closed-system operation with its elimination of tankage reduced the number per station to six. These jobs will be eliminated when the remote control system is completed. Fig. 17.

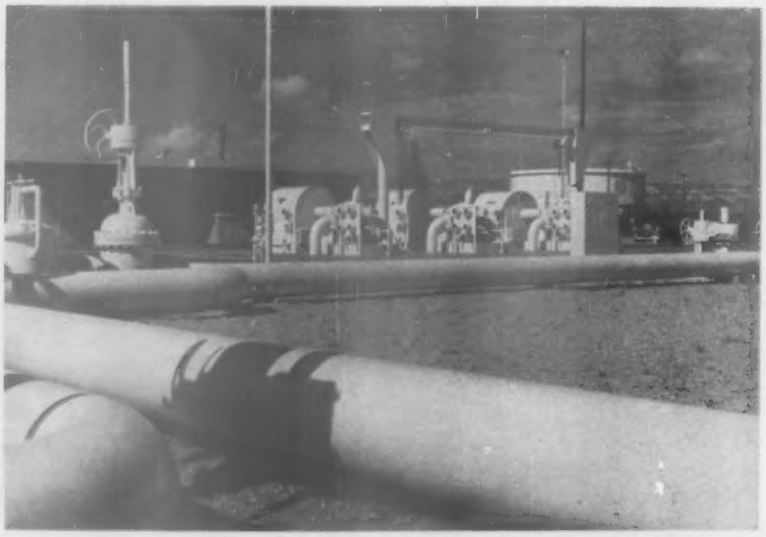
Closed-system. The closed-system method of operation is becoming increasingly common and is influencing the updating of stations. Elimination of tankage cuts down on the functions of the station and makes it more susceptible to remote control and unattended operation.

Another inherent advantage of the closed-system is that, if one station goes out, the horsepower at another can be substituted. The fact that it is a continuous operation is also an advantage since it contributes to simplicity.

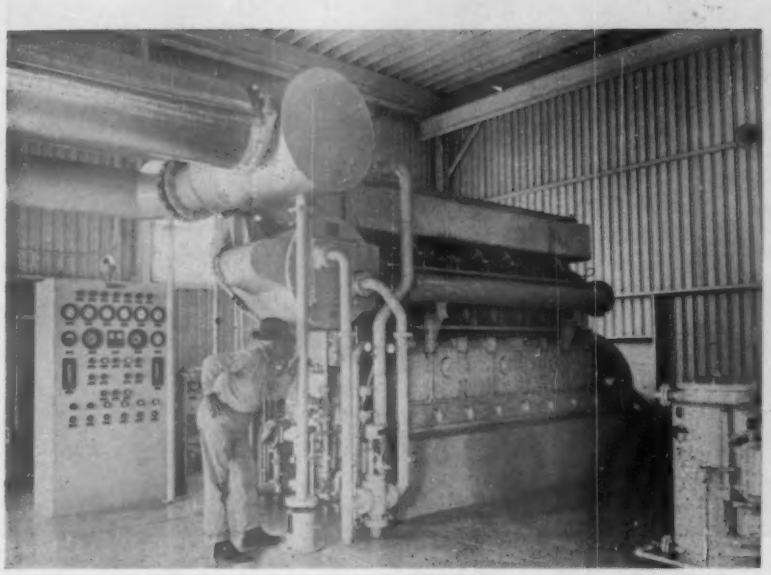
Sinclair Pipe Line Co. has done pretty much the same sort of thing on its Cushing-to-Chicago. This was once a group of small lines which have been replaced with 220 miles of 18-in., 150 miles of 20-in., and 660 miles of 22-24-in.

At the same time the number of stations was reduced from 15 to 8. Sinclair went largely to electric power and replaced reciprocating pumps with centrifugal units. Electric power was preferred because of greater efficiency and simplification in starting and stopping units. Centrifugal pumps were preferred because of their adaptability.

Fluctuating load. Sinclair uses dual-fuel engines where there is a fluctuating load. Service also uses engines on the Fort Laramie-Whit-



MOTOR-DRIVEN CENTRIFUGAL PUMPS at the Fort Laramie station of Service Pipe Line Co., beginning of the 1,100-mile system terminating at Whiting, Ind. Fig. 17.



DUAL-FUEL ENGINES are driving centrifugal pumps at Sinclair Pipe Line Co.'s Teague, Tex., station. These four-cycle, eight-cylinder engines replaced nine smaller units. Fig. 18.

ing line. One of its remotely controlled stations has two 2,000-hp. Alco engines and one of the batching stations has three such engines. Cost of power was an influencing factor in the selection of the dual-fuel engines.

Sinclair's Teague, Tex., station is a good example of the flexibility of the dual-fuel engine. Here two 4-cycle, 8-cylinder, 2,000-hp. Nordberg Duafuel diesels are driving 8-in. United centrifugal pumps. These two replace nine small, engine-driven pumps. Fig. 18.

Variable load was the deciding factor in the choice of power for Teague station. This station delivers crude both to Sinclair's refinery at Houston and to tanker-loading facilities there. Its load can run as much as 20,000 bbl. per day above the monthly average. Its load factor varies from 60% to almost 100%.

Since the short periods of high pumping rates would add considerably to the electric demand charge, thus boosting the operating cost, the dual-fuel engines were decided upon. Flexible couplings and a speed-increasing gear with a ratio of 4.28 to 1 connect the engines to the pumps. The three-stage centrifugals are rated at 5,400 g.p.m. at 1,380-ft. head at 2,200 r.p.m.

Engines housed. Teague's engines are housed in a metal structure with the gears and pumps outside under a roof. All of the auxiliary equipment is electric-driven except the engine and accessory lube pumps.

These engines can use diesel fuel, crude oil, or natural gas as fuel. Diesel fuel is preferred as the pilot fuel and natural gas as the operating fuel. Controls are set up to enable one-man operation from a panel in the engine room.

The engines have pneumatically operated pipeline governors and engine speed can be controlled manually from the engine-room panels or from the control building. Pipeline flow or pressure normally controls the engine speed. Controls are set on the main panel for the desired volume, high discharge, and low suction pressures. The engines run as fast as necessary to provide the desired volume but pressure settings can override the volume control to keep suction pressure above its minimum and discharge pressure below its maximum.

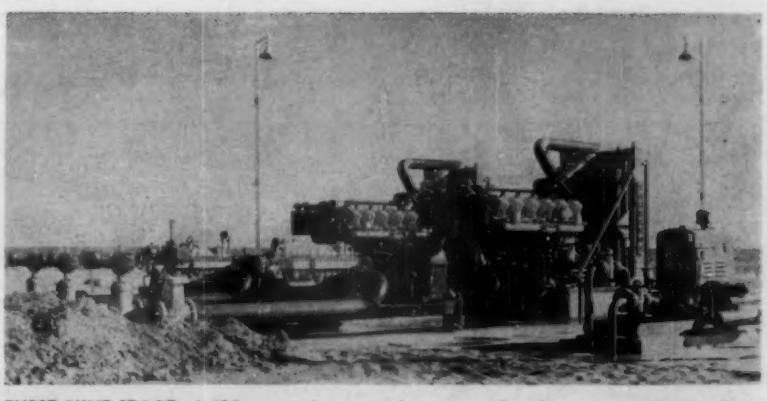
Teague station has a complete alarm and automatic shutdown system with full annunciator panels in the control room. Alarms warn the operator of approaching trouble for some conditions and automatic shutdown for others.

PUMPS—High-speed centrifugals being stressed

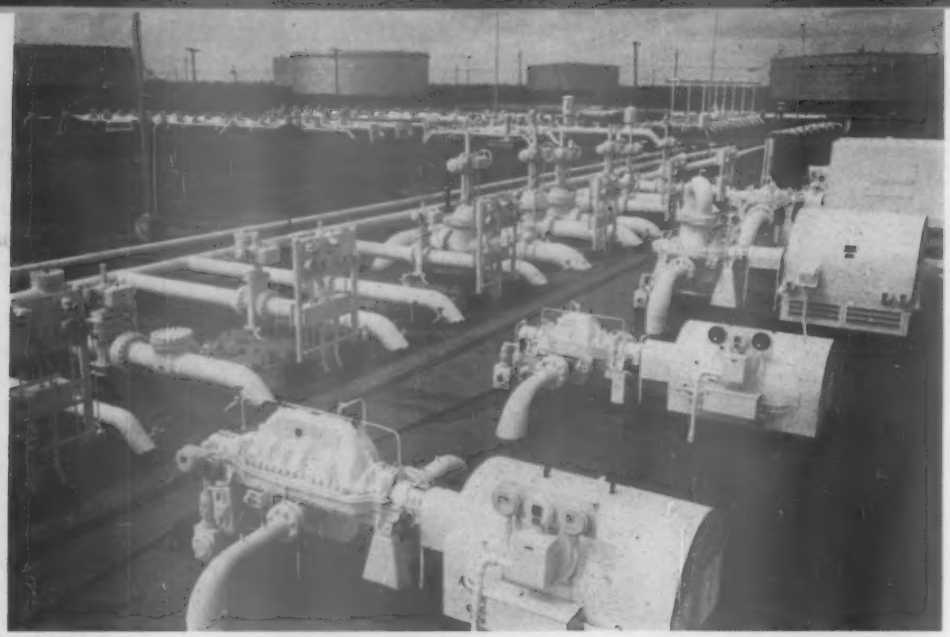
NOT MANY pipeline companies are involved in changes in pumps but those that are, are stressing higher speed, centrifugal units. One of the reasons why centrifugals are preferred is adaptability to control devices.

As one engineer put it, "More strict attention is being paid to pump efficiencies, pressure, flow control, etc. Centrifugal pumps are easily controlled with a minimum of equipment." Figs. 19 and 20.

A veteran chief engineer with one of the largest companies said that reason his company was replacing reciprocating pumps with centrifu-



THESE NINE-STAGE, 4,400-r.p.m. Byron Jackson centrifugal pumps are part of the Kismet, Kans., station of Okan Pipeline Co. They are driven, through Lufkin speed increasers, by 12-cylinder, 960-hp. Waukesha engines. Fig. 19.



CENTRIFUGAL pumps were used in the modernized Satsuma station of Humble Pipe Line Co. These pumps and their electric motor drives are equipped with protective devices. Fig. 20.

gals was that while the capacity of reciprocating pumps was limited, the capacity of the centrifugal pumps was virtually unlimited.

Another company has set the policy of installing centrifugal pumps in all new and revamped stations. Still another is replacing two five-stage, 1,800-r.p.m. pumps in each of the stations on one of its trans-Texas lines with one 6-stage, 3,600-r.p.m. centrifugal pump.

A number of companies are modifying crude-oil pumps in stations with the most common step being the installation of mechanical seals. Quite a few are seeking devices to prevent seal failure. One reason for this change is the increasing volume of condensate and LPG that is being handled along with crude.

One pipeline had devised a kind of solution to the seal problem. It puts a leather seal at the base of the gas chamber. When the pressure builds up to the neighborhood of 3 to 5 psi., a sensitive pressure switch shuts the station down. It plans to install this device at unattended stations.

PIPING—Simplification is the watchword

A LARGE MAJORITY of the oil pipelines are going in for modification of station piping. There is probably more uniformity in this phase of station modernization than in any other. Almost all of it is directed toward simplification.

An indication of the intensity of interest in simplification of piping is apparent from the individual comments of pipeline engineers. Here are a few:

"We have streamlined station manifolds and removed all unnecessary drain valves, etc."

"Station and terminal piping has been simplified so that head loss, fittings, and maintenance are reduced."

"Piping is simplified to eliminate pits and underground piping is removed to eliminate corrosion. Fittings have been changed to minimize the possibility of leaks."

"The modern trend is toward simpler and more efficient piping designs. This is easier to accomplish with 'outside' stations."

"We are placing all piping aboveground wherever possible."

MANIFOLD PIPING in foreground with calibrated-pipe meter prover in the background at Comyn station, Comanche County, Texas, of Humble Pipe Line Co. Fig. 21.

"Our company has one objective: keep them as simple as possible."

"We eliminate complicated distribution and load rack manifolds at new terminals."

"Complete manifolds have been installed in 11 stations."

"We are shooting at more piping aboveground, more weld-in valves, and more nonlubricated valves."

Major consideration. The several references to aboveground piping among the foregoing comments is evidence that it is getting more consideration in station modernization today. Fig. 21.

There are several sound reasons:

The trend toward the complete or partial elimination of buildings makes aboveground piping easier to install. When pumps are exposed, there are no walls to act as interferences.

Ready accessibility is probably the greatest virtue in aboveground piping. This assumes additional importance in unattended or one-man stations.

Simplification is stressed heavily by pipeline engineers. One thing that is contributing to simplification is trend toward closed-system operation. The elimination of tankage at stations has helped to simplify operations. The total or partial elimination of personnel puts a must sign on simplification as an aid to less complex and more reliable controls.

One piping change two companies are making is the installation of devices in lines to indicate the passage of scrapers or spheres. One company is putting in automatic station bypass piping to facilitate spheroid handling around stations.

Continental has installed automatic controls for station shutdown during scrapper runs. It has installed Pig-sigs above and below the station. When the pig reaches the first, the station is shutdown and when it passes the second, the station is restarted.

Buildings—They're an expendable item

ONE very conspicious trend in the modernization of pipeline pump stations is elimination of buildings, either wholly or in part. The old-style structure that housed engines, pumps, controls and office in a single huge building is steadily becoming a thing of the past.

The trend away from huge buildings has been under way for some years. The current trend is toward the complete elimination of buildings in some instances and the use of specialized structures in others.

Much of this has been made possible by methods of operation now in vogue. Remote control, instrumentation, and new equipment have reduced personnel requirements in some instances and eliminated them in others. The more compact and efficient units now available and the reduction in personnel have made buildings totally unnecessary or of limited need.

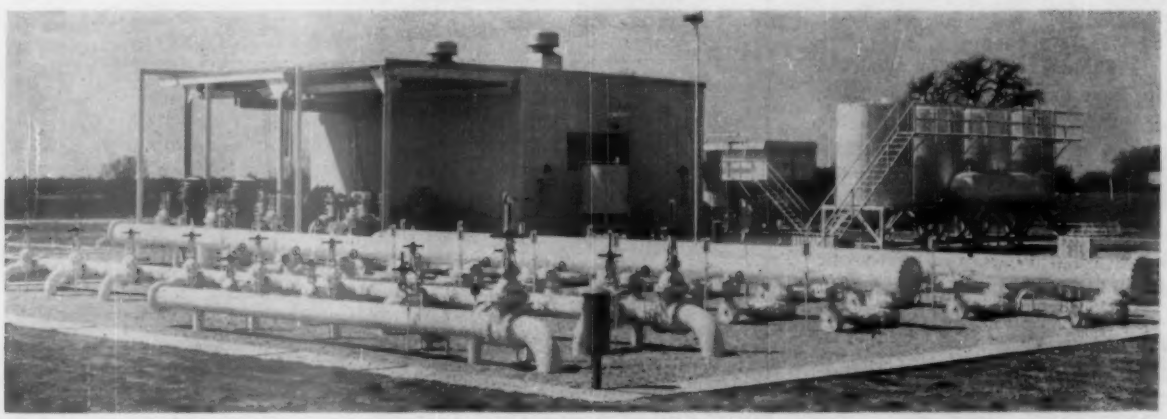
Costs lower. Lower installation cost is one big reason for the reduction in buildings. Another is lower maintenance costs. Still another, and an important reason, is the avoidance of the accumulation of explosive mixtures.

Adequate ventilation was critically important in buildings where motors were housed in the same building with controls. In open-air stations, vapors rising from minor leaks are dissipated into the atmosphere.

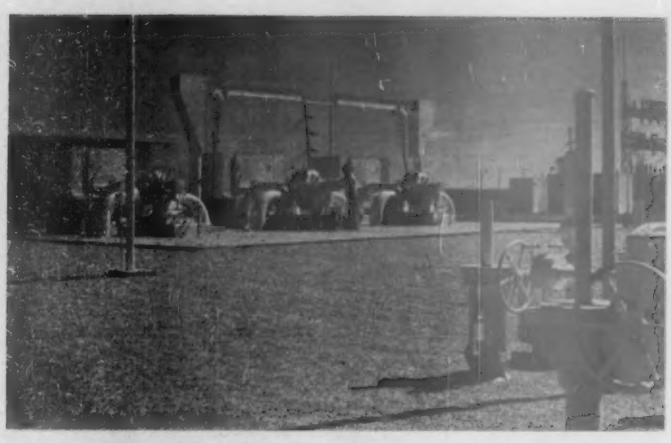
Sinclair Pipe Line Co.'s Teague, Tex., station is an example of a partially enclosed station. Here the two dual-fuel engines and controls are housed in a fabricated metal building. The gears and centrifugal pumps are outside, protected only by a canopy. The intervening wall serves as a fire wall separating the engine room from the gear and pump shelter. Fig. 22.

The canopy was eliminated and both the electric motors and pumps are completely exposed at the Sterling, Colo., station on Service Pipe Line Co.'s Fort Laramie - Whiting line. This equipment can be serviced with a permanently installed, overhead crane. The lone building is the control house. Fig. 23.

Fully exposed. The Kismet, Kans., station of Okan Pipeline Co. is completely exposed. This station consists of two 12-cylinder, 960-hp. Waukesha engines driving 9-stage, 4,400-r.p.m. Byron Jackson centrifugal pumps through Lufkin approximately 4-to-1 speed increasers. Fig. 24.



A CANOPY is utilized at the Teague, Tex., station of Sinclair Pipe Line Co. It covers the pumps while the engines are housed. The intervening wall of the cutdown pump house serves as a fire wall. Fig. 22.



BOTH ELECTRIC MOTORS and pumps are located outdoors at the Sterling, Colo., station of Service Pipe Line Co. A permanently installed overhead crane facilitates maintenance operations. Fig. 23.

STATION of Okan Pipeline Co., at Kismet, Kans., is an example of the ultimate in simplicity. These 960-hp. engines and the 4,400-r.p.m. centrifugal pumps they drive through speed increasers are totally exposed. Fig. 24.

An ideal example of what happens to station buildings when that station is updated is shown in the accompanying diagram of a relay station on the Bayou Pipe Line System between Baytown, Tex., and Baton Rouge, La. Modernization of this line was completed early this year. Fig. 25.

All outbuildings were eliminated. These included a cottage, garages, sample storage building, well house, fire house, and office. The drainage pond was also removed along with unnecessary driveways and the esthetic but unnecessary planting.

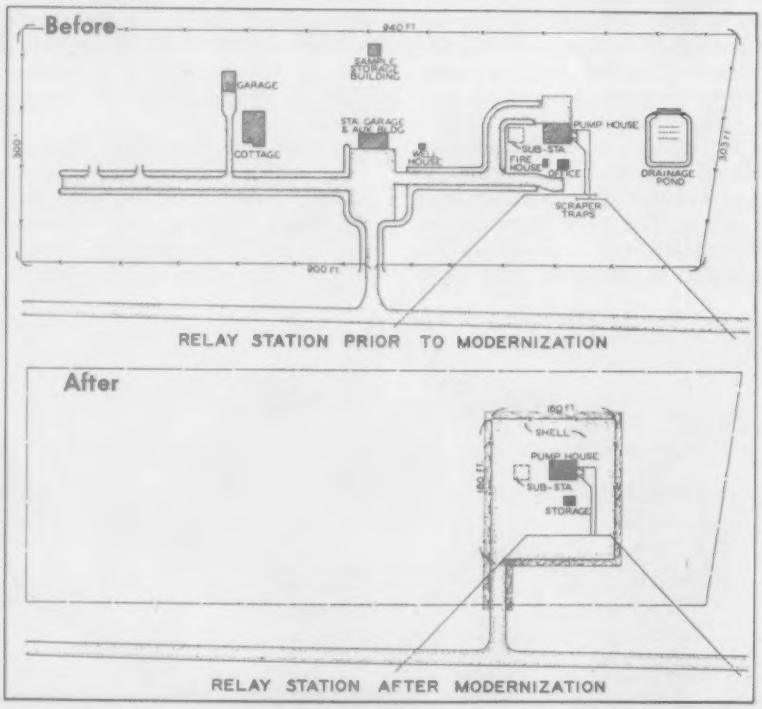
Existing pump houses are two-room structures, one room for the motors, switchgear, and transformers, and the other for the pumps. Forced ventilation was retained for the motor room. Most of the three outside walls of the pump room were removed and a sheet-metal facing added to the partition wall as a protection against the elements.

Functional use. Practically all the pipeline companies that are going in for modernization of stations are limiting the revamped installations either to canopies or open installations. They should be, if buildings are used at all, designed for functional use only, according to one engineer. Maintenance and housekeeping must be kept at a minimum. Buildings at unattended stations, he contends, act as a shelter for automation equipment first and as personnel housing second.

At least two companies are using prefabricated metal buildings for housing control equipment at pump stations. The metal buildings on one of these systems is also insulated.

Another company which is using buildings only to house control equipment is constructing them of concrete blocks. These buildings are windowless and air-conditioned. This company uses solid-state electronic equipment which is sensitive to heat. The heat does no physical damage but does alter the characteristics of some components. Air conditioning prevents or delays this.

Another company is modernizing its stations by eliminating windows and sealing doors to limit air infiltration. Periodic ventilation is provided for. This company uses separate electrical and control buildings some distance from pump buildings.



BEFORE AND AFTER diagram of a relay station on the Bayou System is a good example of what happens in modernization. A half dozen buildings were eliminated and maintenance was sharply reduced. Fig. 25.

UPDATING those older PIPELINE STATIONS

2. Natural-gas pipelines

BY H. C. BOZEMAN
Journal Staff

MODERNIZATION of older compressor stations pays gas pipelines dividends in reduced operating costs and in better transmission efficiency. It gains momentum as the average age of compressor stations increases.

Gas pipelines have been starting modernization programs with caution. They try several approaches before making a final choice. Initially one station or compressor is modernized. Then more stations or compressors are updated after the equipment proves its value.

The reason for the insistence on realiability is down time's high cost. However, a small percentage increase will pay modernization cost many times over.

Modernization should have an economic payout. The payout shows itself in reduced operating costs and higher stream factors. Evaluation may require several years in some cases. Capital charges must be considered before making changes.

Several paths. Gas pipelines have several paths leading to modernization. Equipment records show chronic maintenance problems which demand solutions. Operating records show the changing demands placed on the system by supply sources and customers. New equipment points the direction to modernization.

There are many places to modernize present stations. These are found in compressors, station auxiliaries, tools and maintenance techniques, and controls. It can result in many indirect payouts such as safer stations, increased reliability, and faster and easier maintenance.

Each pipeline has its own particular needs. Stations differ. Therefore, modernization is tailored to the needs of each station. The results come in efficiency and cuts in fuel and maintenance costs.

Here are same specific modernization techniques:

Compressors. Turbocharging lowers specific fuel consumption and increases available horsepower. Manifold-type lubrication systems replace individual force-feed pump units. High clearance compressor cylinders raise transmission efficiency for low ratio operation.

Station auxiliaries. Extra standby, emergency electric generators enable a station to stay on the line even though regular power sources fail. Instrument air dryers improve instrument service factors. Unitized drives for compressor auxiliaries practically eliminate the need for emergency electric power that was previously needed.

Tools and maintenance. Air motors on overhead hoists and air hammers reduce maintenance time. Engine analyzers check engine operation.

Controls. Panels locate all engine controls for convenient start, stop, and operation. Panels can be either elaborate or simple, depending on the objective. Panels are designed for either local or remote operation. Computer controls operate compressor pockets and keep an engine fully loaded at full torque.

Compressors

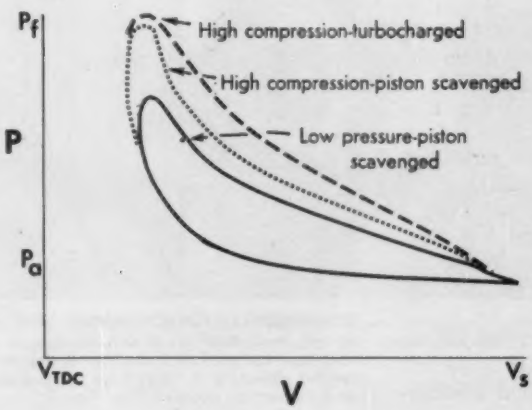
Both the power and compressor ends are being improved for efficiency, throughput, and reliability. Compressor auxiliaries such as lubricators and jacket-water fan drives receive the same attention to improve reliability.

Supercharging of present centrifugal-blower or piston-scavenged two-cycle gas engines is the most advantageous method for increasing horsepower. It is done usually with supercharger kits from the engine manufacturer. The kits offer the most increase in available horsepower with the least cost, changes to present equipment, and down time to install. More horsepower is available from the same number of compressors as before, thus saving building additions.

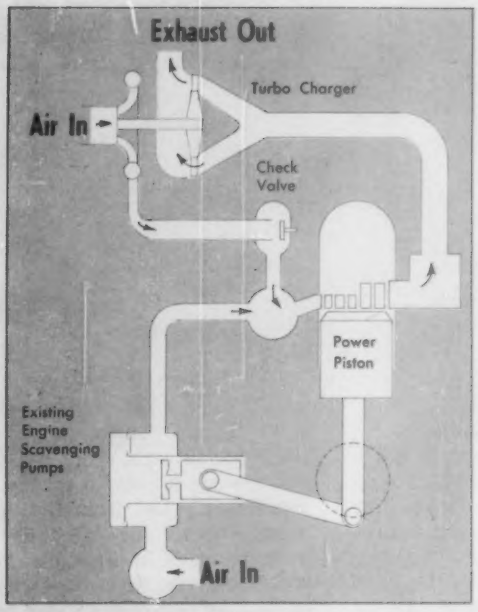
Supercharging reduces specific fuel consumption about 25%. A low-compression piston-scavenged engine has a fuel consumption of about 10,000 B.t.u./b.hp.-hr.

Two steps generally are required to supercharge an engine. First step is to change the power pistons, cylinders, and heads. This will increase horsepower and lower fuel consumption to about 8,300 B.t.u./b.hp.-hr. Fig. 1.

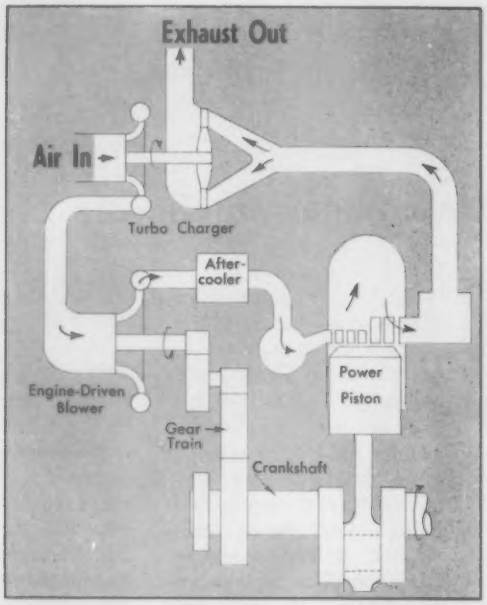
The second step is to install an exhaust-driven turbocharger which converts exhaust energy, formerly wasted, into usable power. Turbocharging will reduce fuel consumption to about 7,500 B.t.u./b.hp.-hr. Advanced designs of supercharged



HIGH compression and turbocharging raise horsepower and cut fuel consumption. Low compression has fuel consumption of about 10 B.t.u./b.hp.-hr., high compression, about 8,300, and turbocharging, about 7,500. Fig. 1.



PARALLEL TURBOCHARGING of two-cycle engines. Turbocharger supplies additional scavenging air to the power piston. Exhaust gases drive the turbocharger. The turbocharger can supply all air by removing the scavenging piston from service. Fig. 2.



SERIES TURBOCHARGING of two-cycle engines. Turbocharger boosts pressure of engine-driven blower. Exhaust gases drive the turbocharger. Engines without an engine-driven blower are supplied with all the air requirements by the turbocharger. Fig. 3.

two-cycle gas engines have fuel consumptions of 6,900 B.t.u./b.hp.-hr. or less.

Two methods. Supercharging is done by two methods. Installation details vary among different types and makes of engines.

The first method is to install the turbocharger in parallel with present piston scavenging. The turbocharger recovers exhaust energy formerly wasted. At low speeds the original scavenging pistons supply most of the scavenging air. At higher speeds and loads the turbocharger supplies the greater portion of scavenging air. Fig. 2.

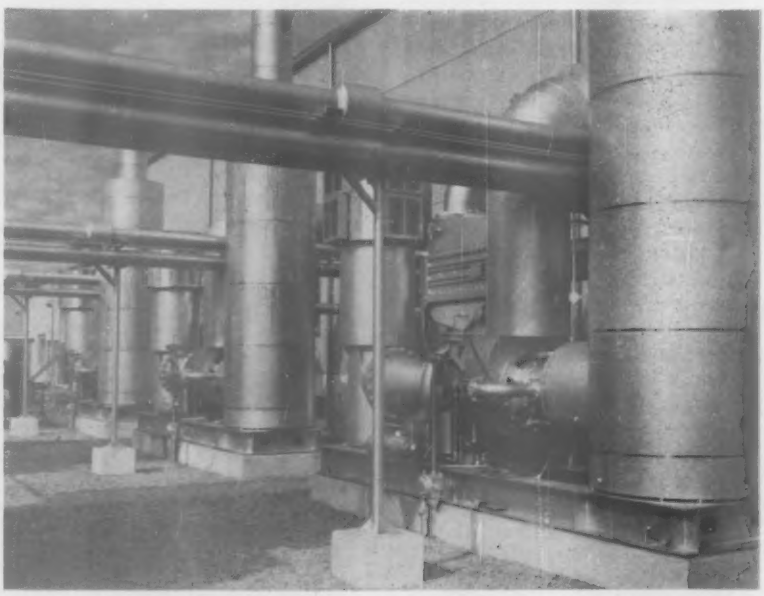
A variation is to remove piston scavenging when the engine is turbocharged. Scavenging pistons at full load absorbs about 10% of the power. Thus, removing them increases the horsepower available to compressor cylinders during high load operation.

The second method is series turbocharging. The turbocharger operates in series with the present engine-driven centrifugal blower. The exhaust driven supercharger recovers exhaust energy formerly wasted. Fig. 3.

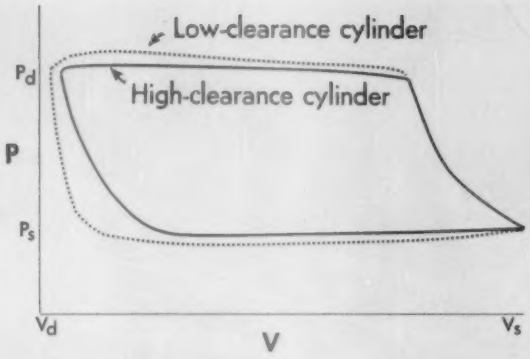
Aftercooling. Aftercooling follows two-stage compression to lower the air temperature for good combustion efficiency. Precoolers and intercoolers can be installed.

Superchargers are either bolted or braced to the engine, supported by an A-frame adjacent to the engine, or mounted on skids outside the compressor building. Superchargers installed on or adjacent to the engine are placed about level with the exhaust manifold. Fig. 4.

Larger gas engines may have two turbochargers. Each turbocharger supplies air to one bank of cylinders in a V-engine. In-line engines may



SKID-MOUNTED TURBOCHARGER UNIT combines the air intake, turbocharger, aftercooler, and muffler. It can be placed outside the compressor building. The skid unit can be prefabricated and delivered before the engine is shut down, thus saving down time. It can be placed near grade level for improved maintenance and inspection accessibility. Fig. 4.



LOW-compression-ratio operation of a high-clearance cylinder is compared with a low-clearance cylinder. The low-clearance cylinder has greater losses through the suction and discharge valves. Fig. 5.

have dual turbochargers supplying a single manifold.

Many two-cycle turbocharging principles apply to four-cycle engines. However, low-compression four-cycle engines are not piston scavenged but naturally aspirated. Early supercharged four-cycle engines had pulse-type turbines. Many of these are being changed to constant-pressure turbines for lower fuel consumption and higher horsepower.

Other changes are made to the engine when it is supercharged.

Dry exhaust manifold. The turbocharger uses both the velocity and heat content of exhaust gases to drive the blower. Wet manifolds remove a large part of the heat from the exhaust gases.

Original cast manifolds are not designed for service without jacket water and will warp, causing power-cylinder misalignment. The dry manifold is made of interconnecting slip-joint sections which prevent misalignment and excessive strains. The joints are covered with insulation and wrapped with sheet aluminum or steel. Removal of the exhaust-manifold load permits the present jacket-water cooling system to be used in the supercharged engine.

Air aftercoolers. They lower air temperatures after compression for good combustion efficiency. A new source of cooling water circulates through the aftercooler. Precoolers and intercoolers can be installed if conditions demand.

Air-intake and exhaust-manifold pressure losses are more critical in supercharged engines. Allowable loss may be 6 in. of water or less for the inlet and 12 in. or less for the exhaust.

Larger piping and low-pressure-loss inlet filters and exhaust mufflers are required to stay within limits.

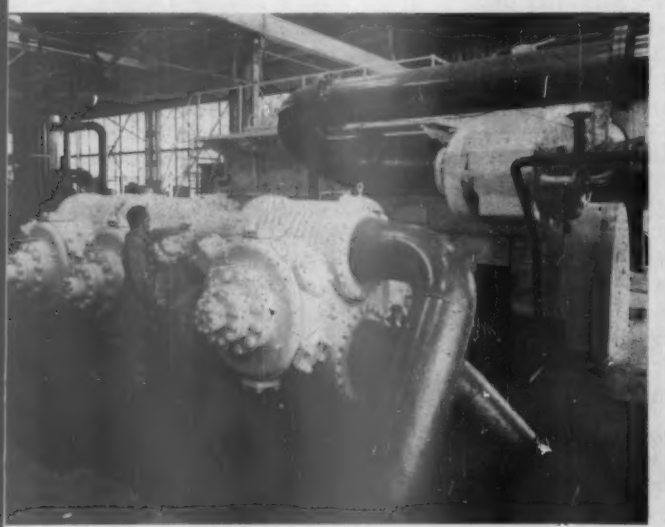
Dry-type intake filters may lower inlet losses. Enlarged flanges and removal of some internal baffles may lower exhaust pressure drop. Sound level should not increase because turbocharged engines are by nature quieter than atmospheric units.

Lube-oil coolers have a heavier heat load to dissipate after an engine is turbocharged. A careful review of the engine and cooling system is needed to find the best and cheapest way of meeting the greater cooling requirement.

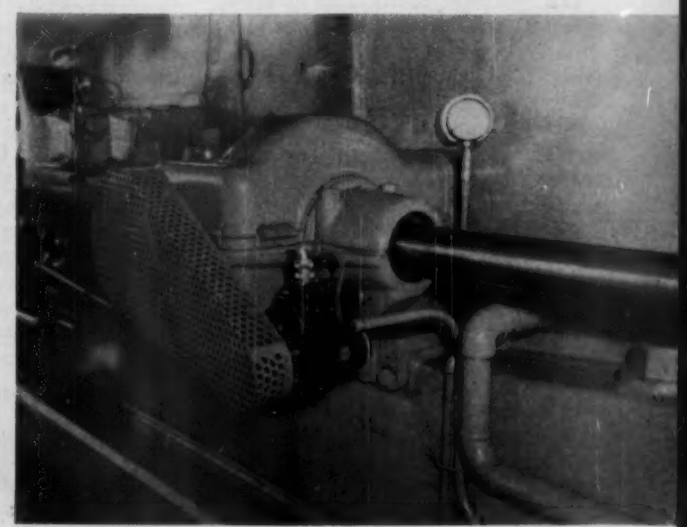
Cylinders. Closer-spaced compressor stations and line looping lower the compression ratio across present stations.

Ratios of 1.35 to 1.4:1 across the original stations change during the capacity-expansion of a project. New ratios range from about 1.1 to 1.2:1. Original compressor cylinders are inefficient at these ratios. Cylinders designed for low-ratio operation have streamlined gas passages and larger clearance volumes. Fig. 5.

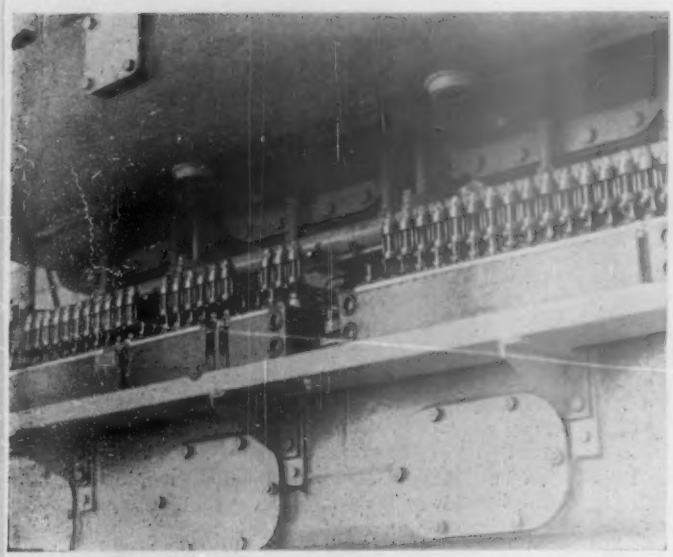
Double-deck valves reduce gas velocities across valve plates and raise cylinder-clearance volume. High cylinder clearances allow the engine to operate on a "flat" horsepower characteristic curve throughout the allowable compression ratios. This means operation without unloading steps. Built-in clearance



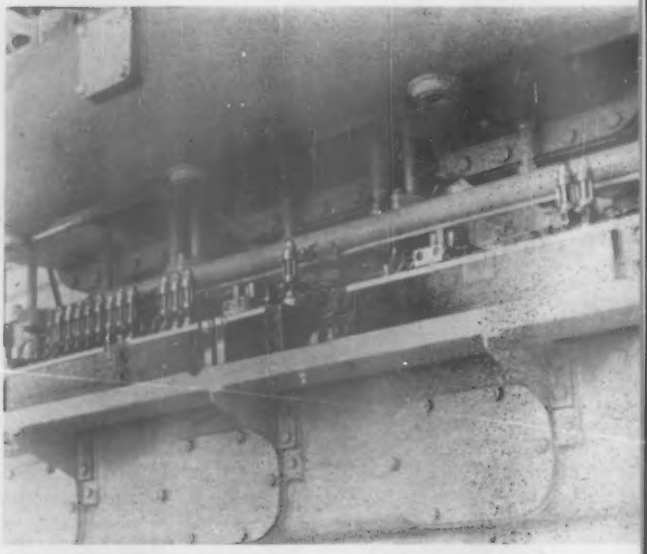
SIDE-CONNECTED CYLINDERS are one method of eliminating the large overhead suction bottles. In this design the suction and discharge bottles are cast directly into the cylinders. Bottom connected cylinders put both suction and discharge bottles under the cylinders. Fig. 6.



CHANGEOVER from interrupter type to magneto ignition is being made by Cities Service Gas Co. The magneto is mounted on the main frame near the cross shaft and is belt driven from an extension to the cross shaft. Fig. 7.



CONVENTIONAL mechanical force-feed-pump lubricator box. Each pump supplies an individual lubrication point. Power cylinders are supplied by the box at the right, compressor end by the left box. Fig. 8.



SAME LUBRICATOR BOX after installing the sequential manifold distribution system. Note that only two pumps remain in right-hand box. These supply the primary distribution block mounted on top of the box which supplies the secondary blocks and injects oil into the 16 points of lubrication. Fig. 9.

volumes or valve cap unloaders provide unloading.

Analog computers simulate piping and pulsation bottle operation. Low-compression-ratio operation is not confined to reciprocating compressors.

Installation of low-ratio guide vane, impeller, and diffuser in the original case permits operation at lower compression ratios without surge. Throughput is increased.

Pulsation, vibration. Pulsation and vibration continue as a problem with reciprocating compressors. Large overhead suction bottles are not satisfactory. Their location above the cylinders makes bracing difficult.

The suction bottles' large size prevents efficient maintenance. Now cylinder removal requires two steps. First the suction bottle is removed and second the cylinder.

New design cylinders have bottom or side-connected piping. Bottom-connected cylinders tie directly into pulsation bottles under the compressor. Thus, for a change, both suction and discharge bottles can be supported. Fig. 6.

Side-connected cylinders have pulsation bottles cast integrally into the top and bottom of the cylinder. This method keeps all gas piping above floor level and no basement is needed.

Fuel-gas shutoff valve replaces former ignition grounding. The valve is safer because all fuel gas in the gas manifold is burned or vented before the ignition is grounded.

Valve required. All compressor shutdown monitors actuate the fuel gas shutoff valve. Piping codes now require this valve.

Safety is increased because of less possibility of an explosive mixture remaining in the power cylinders and flowing into the exhaust and air-intake manifolds. Damaging explosions and backfires have occurred when starting has been attempted with gas present in these places.

Magneto ignition is being used by Cities Service Gas Co. to replace the interrupter type. It has been installed on 100 engines and is being installed on others. The magneto is mounted on the main frame near the cross shaft and is belt-driven from the cross-shaft by a timer belt. A distributor is mounted on the end of the lay shaft. Fig. 7.

Lubrication

The conventional system of an individual pump to supply oil to an individual lubrication point is giving way to a system using a single supply source and sequential manifold distribution to all lube points. Figs. 8 and 9.

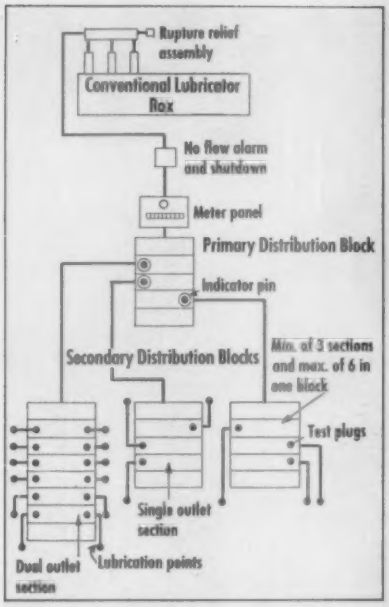
These systems offer many advantages over individual pumps. Only one alarm device need be installed for the whole force-feed lube system rather than an alarm on each pump. The amount of oil delivered to each point is metered exactly by piston-type distribution blocks.

Mechanical supply pumps can operate between half and full capacity where stroke-to-stroke output is more uniform and vapor locking is not a danger.

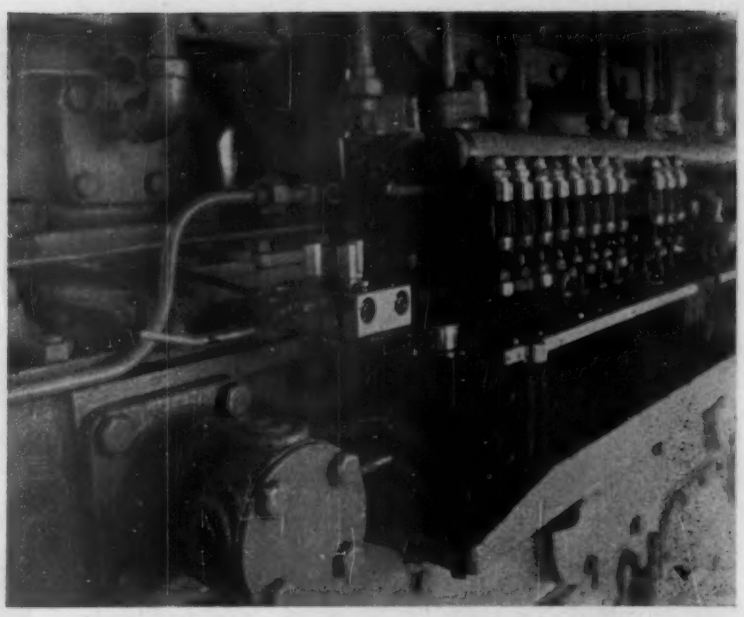
Every point is lubricated sequentially in small, precise, and frequent increments. If one point becomes blocked the system stops and indication is made to denote the stoppage.

Manifold system operation. First, a mechanical pump supplies lube oil at elevated pressures to the primary distribution block. Then, the primary block sequentially supplies each secondary block. Finally, the secondary block distributes oil in sequence to each lubrication point. The cycle repeats itself. Figs 10 and 11.

The amount injected to each point is the volume displaced by the piston in the secondary block. Piston size in the secondary block should be held to a size that gives proper frequency of lubrication. Timing should be in a range that delivers oil 4 to 6 times per minute to a lube point. Timing is changed



MANIFOLD distribution system. Indicator pin will show which secondary block has blocked line. The test plug that squirts oil when loosened is the blocked point. Fig. 10.



DISTRIBUTION BLOCK of a sequential manifold system. Lube lines to two injection points are connected to near side of block and third on far side. Hexagonal nuts on top of distributor are reset indicators. They pinpoint high pressure at an injection point for quick trouble shooting and repair. Fig. 11.

by altering either supply pump speed or volume. This changes the injection timing for the whole system. For example if the supply increases the pistons in the distribution blocks operate more frequently to deliver the greater quantity of lube oil.

The amount of lube oil delivered per stroke to a lubrication point can be changed by removing that section in the secondary block and inserting a section with a larger or smaller piston, as the case may be. Metering accuracy is retained even against varying back pressure with the manifold system.

Individual supply pumps for each lube point are difficult to adjust and balance properly. The amount of oil delivered to the individual pump system requires an adjustment to each pump. The manifold system requires only one adjustment.

Central alarm. The manifold system is the easiest way to have a central alarm system. If one point blocks an alarm or shutdown, device operates. An indicator pin on the distribution blocks permits fast trouble shooting for speedier repairs. A master counter meters the amount of oil going into the compressor. The counter can be used to check supply-pump operation and actuate a shutdown or alarm system when counts fall below a certain rate. Counts can be monitored remotely by telemetering. Also, a no-flow instrument will actuate shutdown or alarm.

Bearing wear from underlubrication can be detected and the increased clearances used to operate alarms and shutdown devices.

Payout of the system is by the manpower saving required to clean sight glasses and force-feed pumps of conventional systems. Elimination of the sight glass liquid of water, glycerine, or mixtures of the two stops plugging and gumming that occur in feed lines and at injection points.

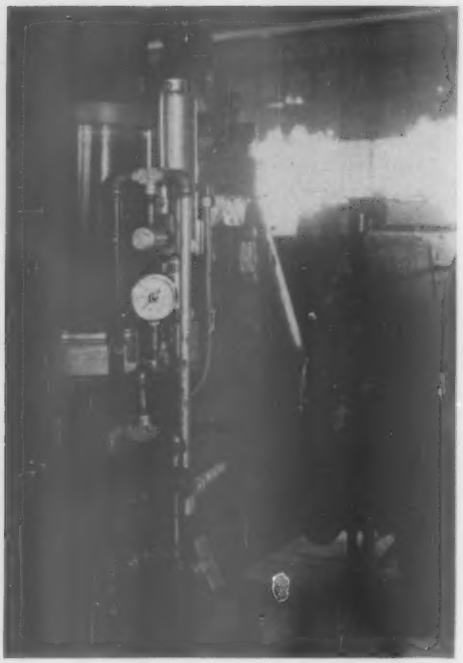
Gas pipelines generally lubricate both power and compressor ends with the same oil. However, a split system varys the amount of oil delivered to each. The amount of oil entering the compressor cylinders determines how much oil is pumped into the pipeline. Some major gas pipelines have removed as much as 250,000 gal. yearly of the lube oil from suction scrubbers.

More accurate metering is one step that will lead to a better understanding of the amount of lube oil each lube point requires. The cost of the manifold system on a 2,000-hp. compressor complete with all shutdown and monitoring devices is about the same as a conventional force-feed system. On larger-horsepower units the cost of the manifold system is less.

Automatic oiling. For years Cities Service has been using the same oil for power and compression cylinder lubrication as is used in the main engine oil system. The cylinder oil was new and lost as soon as it was pumped into the system whereas the engine oil was drained periodically before it became acid and damaged the bearings. It was found that lubricator pumps often became air locked due to air entrained in the oil as it was pumped into the measuring cans and poured into the lubricating tanks.

An automatic oil system for the cylinder-oil supply was installed to correct these problems. From a connection installed on the bearing-oil piping system, oil flows through a second filter and oil meter to the lubricators. Fig. 12. Oil level in the lubricators is controlled by a small float and a needle valve in each tank. To maintain the proper engine-oil level, a float and a control valve were installed in the engine-oil tanks. The oil supply to the engines comes from the main 8,000-gal. storage tank. A pressure of 15 psi. is maintained on the oiling system.

OIL passes through a filter and meter to the lubricator from this takeoff on the bearing oil piping system. Fig. 12.



THIS PNEUMATIC-operated pump can grease 200 points. It is mounted on the floor between two twin-type engines. Fig. 13.

Cities Service is using Alemite equipment for automatic greasing of those points on the engine which were being greased periodically with a hand grease gun. It has been installed on 30 engines and will be added to 30 more.

Its pneumatic-operated pump has a capacity sufficient to grease 200 points. The pump is mounted on the main floor between two of the twin-type engines Fig. 13. Copper tubing carries the grease to the injection valves which have a definite capacity for each cycle of the greasing system. Fig. 14.

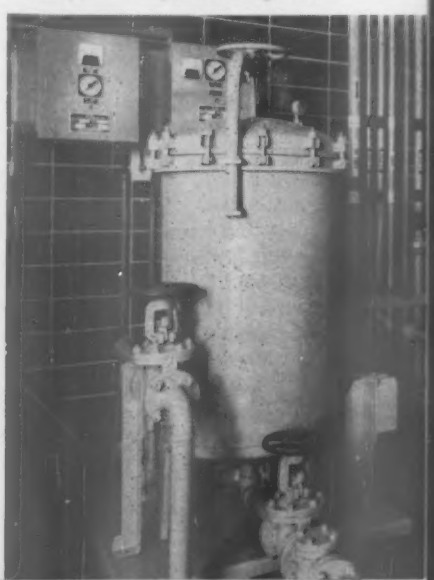
The system consists of two points on each of the 24 bearing feet of the compressor, distance piece, and tail piece, and three points on each side of the eight inlet-valve mechanisms. Air supplied to the pneumatic pump at 60 psi. is controlled by an electric timing and solenoid valve. The timer can be set for intervals of from 5 minutes to 24 hours. Three-hour cycles have been shown to give sufficient lubrication without excessive greasing of any points. Since the supply tank holds approximately 30 days' supply, the system requires very little attention from operating personnel.

Full-flow filters. These are almost universal on new engines. Not so as recent as 10 years ago when bypass filters were still in their heyday. Supercharging and other maintenance and modernization work gradually have caused the change. Greater use of aluminum bearings helped speed greater use of full-flow filters. Fig. 15.

Aluminum bearings have excellent load-carrying ability but a poor tolerance for particles unlike the babbitt-metal bearings. Filtering to 5 μ or less particle size is man-

COPPER TUBING carries the grease to the injection valves which have a definite capacity for each cycle of the greasing system. Fig. 14.

FULL-FLOW FILTERS provide the ultimate in protection against particles being carried into the oil system. Replaceable filter elements inside the filter's steel shell operate in parallel. Fig. 15.



datory to keep aluminum bearings from premature failure.

Station Auxiliaries

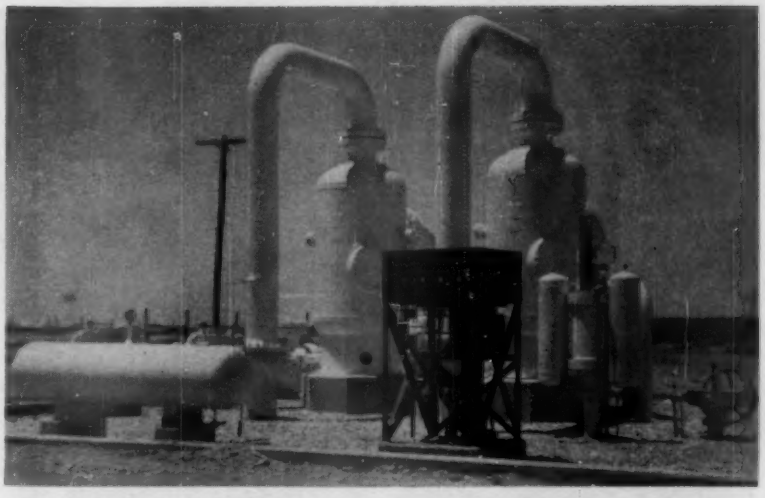
Control instruments for station auxiliaries permit operators to devote more attention to compressor operation.

A station may have several systems to insure continuance of electric power. Gas-engine-driven electric generators supply all electric needs. A standby circuit connects the station to the local utility. To serve when these sources fail, two other sources of emergency power are installed. The first such source of emergency power is gas-engine-driven generators for engine control and emergency lighting. If these generators fail, storage batteries automatically take the load. Fig. 16.

Generally, the electric generators are dualed to increase reliability. Thus, a station can stay in operation after an initial failure. Shutdowns can be planned with more flexibility.

Auxiliary jacket-water systems serve the generators, air compressors, and other auxiliary engines. Temperature recorder-controller keeps jacket-water temperature within set points by controlling fan pitch or air-cooler louver position.

Wide ambient-temperature variations at some stations will still require a manual off-on switch.



EMERGENCY STATION PANEL contains all controls needed to bypass station and stop compressors. Gas in station piping is vented from the valve to right of shutdown panel. Fig. 17.

Auxiliary engine-protective devices permit unattended operation of station auxiliaries. Some of these if not already installed are: engine overspeed shutdown, low-engine-oil-pressure shutdown, high-jacket-water-temperature shutdown, and low-jacket-water-temperature alarm.

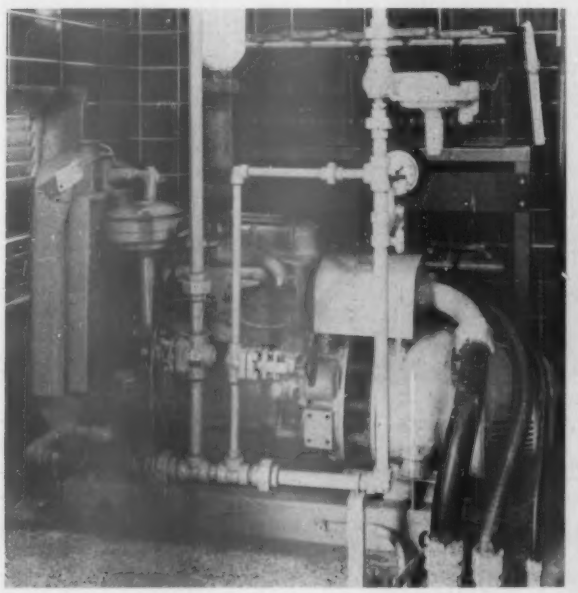
Emergency shutdown. The station should be shut down and bypassed with all possible speed if a fire or explosion occurs. A shutdown panel is located remote from the compressor buildings for this purpose. It contains necessary controls to shut down the compressors, bypass the station, and bleed gas from the station piping. Fig. 17.

Other equipment. Pipelines install more reliable equipment as station age increases. Part of this replacement is for maintenance efficiency, however. Once again, the change is gradual. It is begun at one station and when the practice is proven it is moved to other stations.

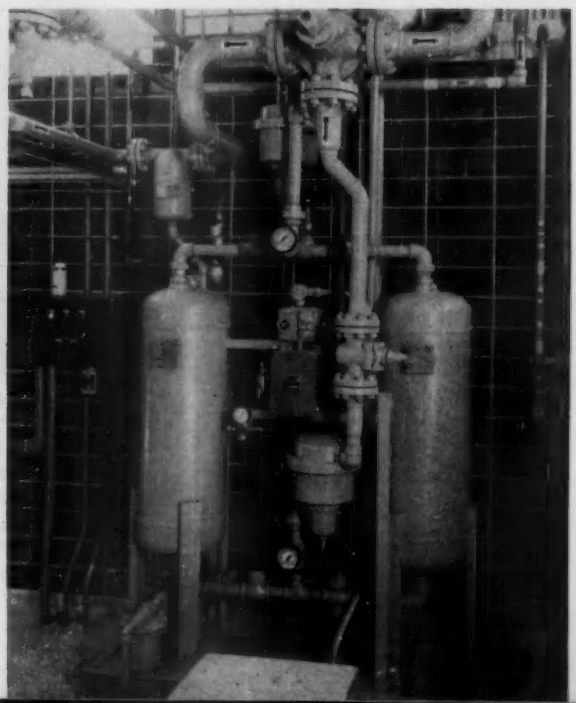
Here are some examples:

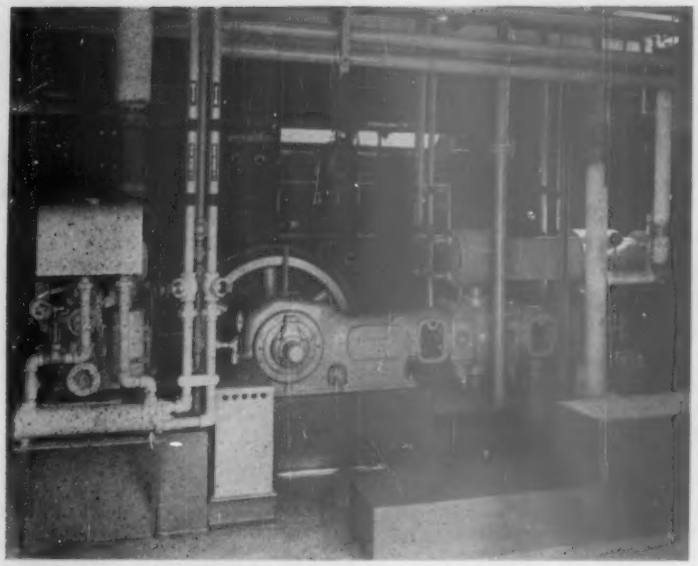
Hydraulic drives. Some unitized designs have individual jacket-wa-

EMERGENCY GENERATORS switch into action whenever normal power sources fail. If generators fail, storage batteries (background) take the load. Fig. 16.

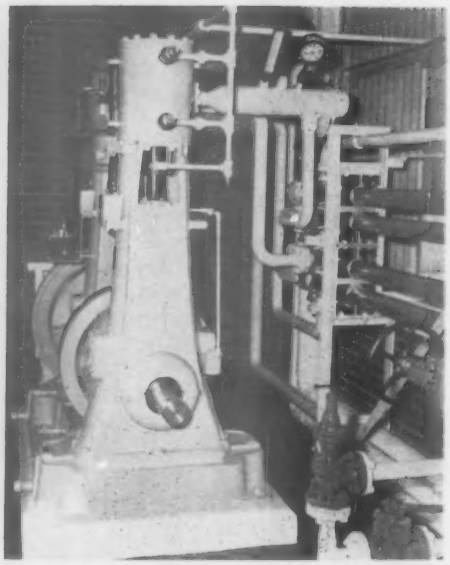


INSTRUMENT AIR DRYER insures dry air for pneumatic instruments. A timer cycles the dryer beds. Air is filtered before entering to remove entrained water and particles. Fig. 18.





DUAL-DRIVE air compressor supplies the station with compressed air for instruments, air-operated tools, and starting air. A dual-drive electric motor (behind engine) gives reliability for all conditions. Fig. 19.



THIS DUPLEX ENGINE acts as a pressure-reduction valve, taking gas from main line to level for use in station. It drives a 75-kw. generator and supplies all of the station's electrical requirements. Fig. 20.

ter systems. The gas-engine crankshaft drives a hydraulic pump to operate a hydraulic motor driving the jacket-water cooling fans.

Redwood towers give way to transite siding and polyethylene fill. Grating replaces polished concrete and tile floors. Aluminum windows replace other window materials to cut painting costs.

Instrument air dryers provide clean dry air for pneumatic instruments and improve operation and cut maintenance costs. Automatic controllers cycle the dryers through a predetermined cycle of on-stream and regeneration. Fig. 18.

Automatic control of air compressors increases reliability and ease of operation. Dual drives of electric motors and gas engines provide continuous source of compressed air for instrument, starting air, and maintenance. Fig. 19.

Fire-extinguisher systems and fire monitors raise the station's ability to fight fires. Gas detectors monitor critical locations for presence of gas and can sound alarms and shut down the station if desired.

Texas Gas Transmission Co. is getting its electric power free at its Hardinsburg, Ky., station. It has installed a Skinner expansion motor which is used to drive a 75-kw. generator to supply all the electric power needs of the station. Fig. 20.

The duplex engine serves the same function as a pressure-reduction valve. It takes gas from the main line and steps it down in successive stages to 260 lb. and to 75 lb. for use in the station. Since no gas is consumed or lost in the operation, the power developed is a 100% byproduct. The station is reported to be saving $5,100 per year in electric power costs.

Tools and Maintenance

Turbocharging brings increased demands on station personnel for keeping the higher-performance engines and compressors in top condition. This in turn brings to the stations a modernization of tools and maintenance techniques.

Air-operated impact wrenches, overhead cranes, and valve lubricators shorten maintenance time. Also, mechanics are relieved of much physical effort formerly required. They can do a better job in less time.

Wet-type vacuum cleaners speed station cleanup.

Analyzer role. Engine analyzers play an important role in keeping gas-engine compressors operating at peak performance. These analyzers can do a variety of jobs. An important one is to balance two-cycle-ator to discard previous hit-or-miss gas-engine power pistons. Another is to analyze the ignition system, and another is to check operation of compressor clyinders and valves.

Engine analyzers permit the opermethods of spotting engine trouble. They are more than just a method of studying engine operation. Continued routine use and record keeping will reveal developing conditions before they are serious enough to actuate an engine-shutdown device.

Engine analysis is done with the engine on stream. Thus, pipeline operation is not interrupted and shutdowns can be preplanned based on data from the engine analyzer. Shutdown work can be planned for specific items rather than for a general inspection. Also, shutdowns can be timed better for minimum-demand periods when engine conditions are known.

Value of analyzer. The greatest advantage of engine analyzers is realized when used routinely for proper engine balance which is reflected in minimizing fuel consumption.

An engine should be balanced every week for best results. The weekly check begins with an ignition-system check. Any defective coils, spark plugs, etc. are replaced. Pyrometer readings on each cylinder are recorded. Then the indicator cock is opened on each cylinder which cleans debris from the cock and finds whether the cylinder is dead.

The indicator is placed on the

whet: Very often it becomes easier to cut through to the core of a problem when one man's thinking sharpens another's. At least that has been Ethyl's experience during 38 years of working closely with refiners on problems of mutual concern.

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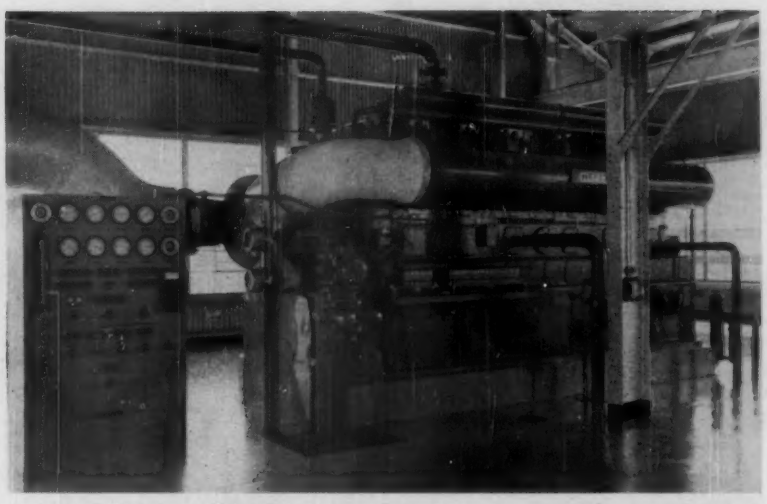
PI-METER measures the average pressure in a cylinder in pounds per square inch. Pressure readings are taken on all cylinders and then averaged. Then each cylinder is balanced to the average value. The instrument is portable. Fig. 21.



ENGINE-CONTROL PANEL BOARDS are located close to the engine. Electric lights in center give shutdown indication. Manometer at left checks turbocharger blower suction and discharge pressures. Fig. 22.

cock and a pressure reading taken. A Pi-Meter will read mean pressure which is related to horsepower. Engine indicators of several makes will show peak pressures which is not related to horsepower. Fig. 21.

A pressure reading is taken on each cylinder and an average pressure is calculated. The indicator is replaced on each cylinder and the pressure is balanced to the average by adjusting the cylinder's fuel-gas valve.

Peak pressures do not reflect the power developed by the cylinder. Early or late ignition has considerable influence on the peak pressure. Also, detonation has little power but a high peak pressure.

Above all, experience is essential for keeping the engine in proper balance. Through practice the operator will learn the response of each cylinder and the meaning of variations in indicator readings.

Portable indicators. These are convenient for routine use to keep engines in proper balance. There are times, however, when a more detailed analysis is demanded. These times call for instruments that are more elaborate.

The MIT engine analyzer is a mechanical-electric instrument used to make more detailed studies. It makes time-pressure diagrams of power and compressor cylinders on paper for permanent records.

Electronic instruments are available, also. These instruments use an oscilliscope for presenting the pressure-time diagrams. Through switching circuits the diagram can be converted to pressure-volume diagrams. Photographs of the diagrams make possible permanent records. If desired, certain parts of the diagram can be magnified on the oscilliscope for closer study.

Proper use of engine analyzers will minimize fuel consumption and help pinpoint shutdown work, thus cutting down time.

Other instruments. Vibration analyzers and sound-survey equipment help reduce the possibility of premature failure.

Vibration analysis of gas turbine and centrifugal compressors will show any increase in displacement and permit shutdown before damage occurs.

Sound surveys may be used to detect changes in the sound level before changes in vibration levels are detected. However, much experience is needed to correctly interpret sound survey data.

Analog computers for simulating compressor stations reduce the chance of fatigue failure. Design of compressor piping and pulsation bottles is critical because rupture or failure of any of these components could result in a serious fire and explosion at the station.

Controls

Engine-control panels find increased favor with gas pipelines to increase safety of compressor-station operation. These panel boards provide one place to locate all engine controls and instruments. They remove much of the human error which occurred when controls were located many places around the engine.

Panel-board design is not yet standardized. Each is fitted to the station and the operating experience of the pipeline and engine manufacturer.

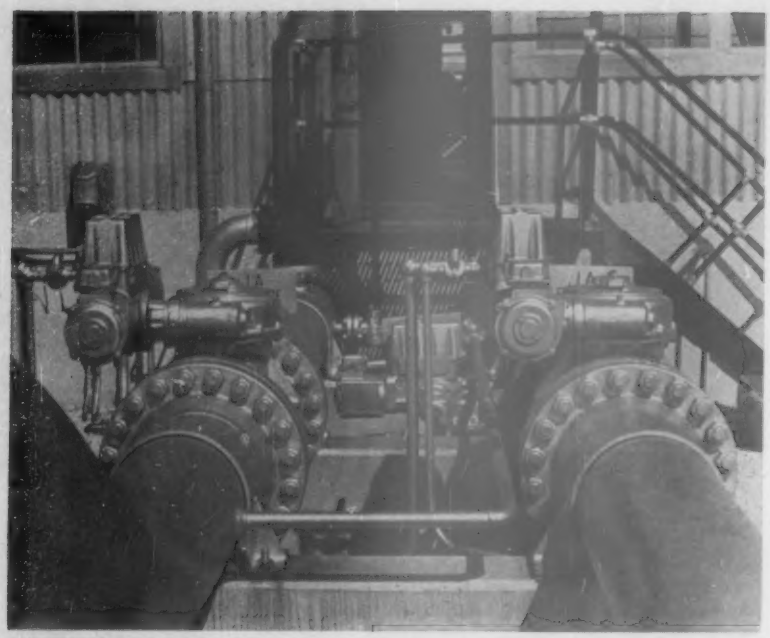
The problems experienced in compressor operation at that station, pipeline, and model engine are built into the panel's control circuits. Sensing devices and interlocking and overriding controls are combined to interpret engine operation, and to alarm or shut down, whichever is the case.

Telemetering can be added if desired, usually by adding additional panel boards that contain the analog-to-digital converters.

Alarms and lights actuate when a malfunction occur. These flag operator's attention. The operator then looks at the panel for the malfunction indication and takes action.

Controls must prove more reliable than engine components being monitored. Some panels for this reason merely are a central place to locate the instruments and controls. Start and stop is manual and the operator controls all steps at the panel. Fig. 22.

Sequential start-stop panels saves the operator much manual effort to start and stop a large gas-engine compressor. The panel is wired for



ELECTRIC OPERATORS on compressor suction, discharge, and bypass valves. Manually controlled switches are mounted on engine panel board beside the engine. Fig. 23.

all controls to sequence in a preselected order and time. If one item in the sequence does not reach its preset limit the entire sequence up to that point is shut down. Malfunction is indicated and repair work can begin immediately. Over 30 steps generally are done to start and stop a compressor including opening and closing suction and discharge valves. Fig. 23.

Panels and control equipment are tested for reliability at single installations before embarking on a system wide program. Field adjustment should be minimized by using controls that do not have adjustment. A change of elements is the only way to change the setting of these instruments. Fig. 24.

This procedure lowers maintenance requirements and helps standardize equipment and operating conditions.

Horizontal engine monitoring panels are being evaluated at some stations. Each panel monitors the same pressures and temperatures but components and circuitry in each panel are different to evaluate operation and reliability.

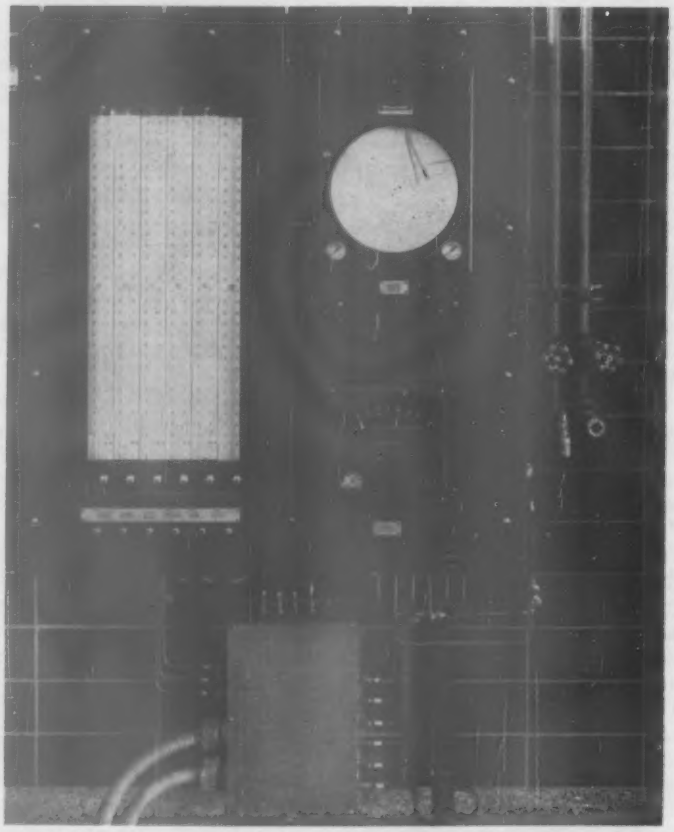
The panels give visual and audible alarms on high main-bearing temperature, high cylinder-jacket-water and power-piston-rod-water temperatures, low lube-oil pressure, and engine overspeed. Also, engine overspeed will shut down the engine.

Temperature and pressure-sensing instruments with control panels are being installed by Cities Service Gas Co. at its older stations. They will sense four jacket-water temperatures, four rod-water temperatures, two main-bearing temperatures, two crosshead bearing temperatures, two crank-bearing temperatures, two compressor discharge-gas temperatures, and one lubricating-oil pressure.

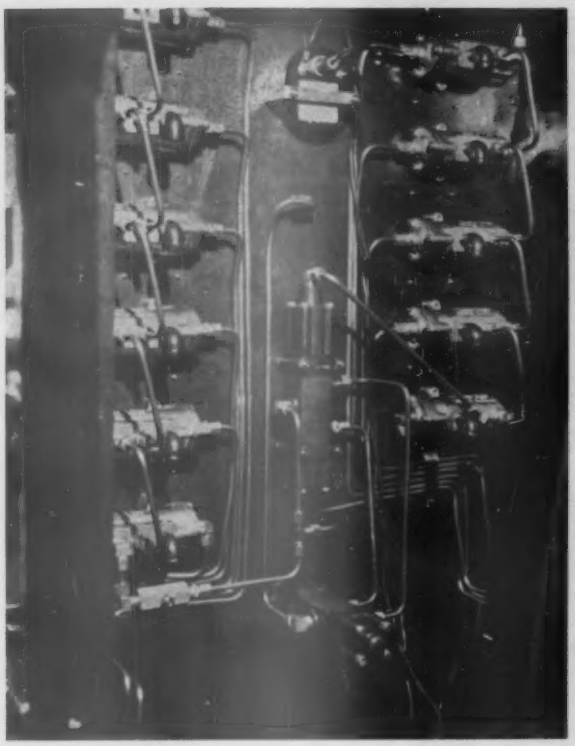
The devices are pneumatically operated and are connected to the indicating instruments on the control panel by copper tubing. Fig. 25. Should a malfunction occur at any point an alarm is sounded.

The system has not been connected to the engine shutdown system. The instruments have been installed to permit the operator to observe the trouble and remedy the condition without taking the engine out of operation. Each of the control panels has a tachometer which reads the r.p.m. directly.

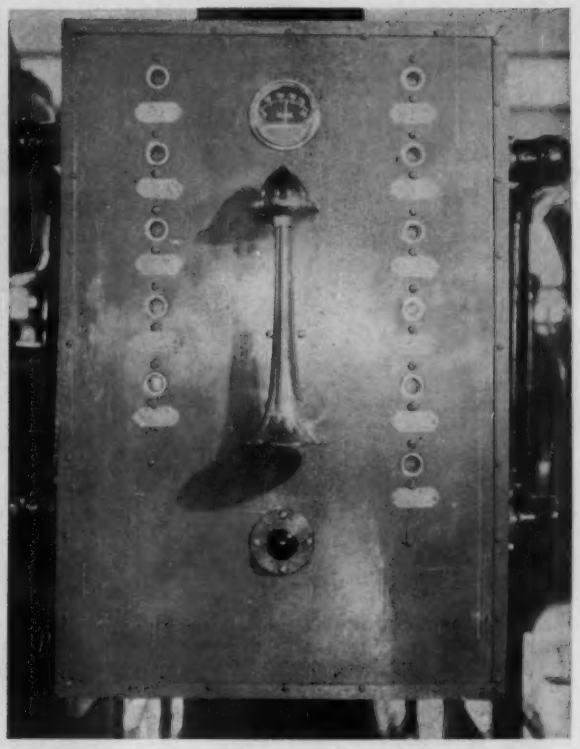
The panel is located directly in front of the main engine flywheel.



TURBOCHARGER CONTROL PANEL groups its instruments together for ease of control and surveillance. Fig. 24.



REAR VIEW of temperature control panel showing copper tubing from pneumatic sensing device to indicating instrument. Fig. 25.



FRONT VIEW of temperature-control panel. It is located in front of main engine flywheel which contributes to shortening of tubing between sensing element and control panel. Fig. 26.

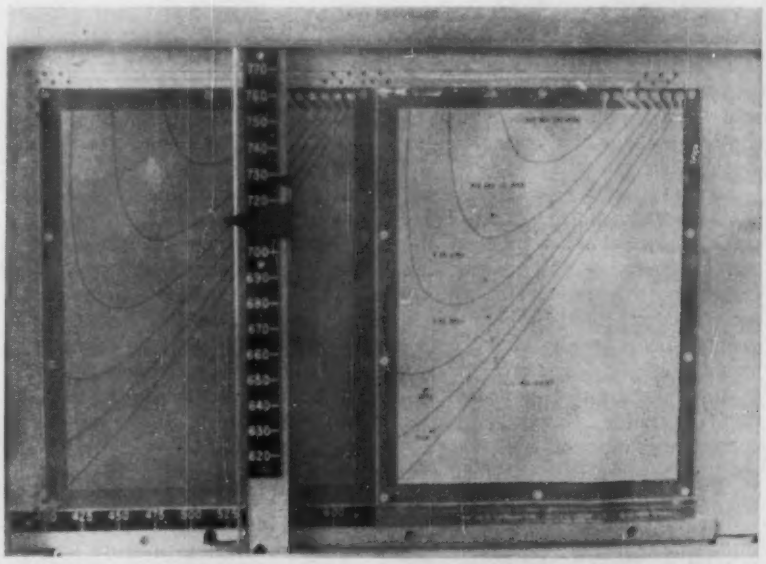
Fig. 26. This made it possible to shorten the length of the tubing between the sensing element and the control panel. Here the instruments are readily accessible for repair. If the system should be tied into the shutdown control, the panel is near either the engine-ignition system or fuel-gas system.

Computer control of one installation is done with an analog computer. The computer will start and stop engines, and adjust pockets and speed. Load control is kept within engine-design limits as called for by a preselected variable discharge-pressure set point. The computer will calculate the minimum number of compressors needed to operate at full torque or horsepower to maintain set discharge pressures under varying load conditions.

The operator exercises control over the station with two controls. One is the station discharge pressure and the other is to give the computer permission to start another engine. The computer has direct control of engine operation and the operator has only indirect control.

Indicator lights and a logging typewriter present information about compressor operation.

"X-Y" recorder is another means being evaluated to adjust pockets. Compressor operating curves for various pocket setting combinations are plotted in an X-Y plot on an electrically conductive sheet. The area between each curve connects to a circuit that controls opening or



"X-Y" RECORDER. Suction and discharge pressure locate a coordinate point and the metal stylus pointer contacts a circuit to indicate pocket positions to maintain a full load and torque. Fig. 27.

MASTER STATION CONSOLE through which Texas Eastern Transmission Corp. will control functions of three satellite stations. Eventually the control system will be extended to 128 stations. Fig. 28.

PLASTIC GROUT is credited with several advantages over conventional material. It is impervious to oil, fast hardening, strength increases with settling, bonds to metal and concrete and is resistant to most chemicals. Fig. 29.

closing of preselected pockets. Fig. 27.

Both suction and discharge pressures are transduced into an electric signal and fed to the recorder. The suction pressure is on the X axis and the discharge pressure on the Y axis. A metal stylus on the pointer tip at the X-Y location contacts the metal sheet which in turn closes the circuit and indicates the pockets to be opened or closed.

Conclusions. Many of the control devices installed at old stations serve as a testing ground for new station design. The concepts worked out in actual operation make the design of control systems for new stations much easier.

Justification of controls and panels is based on reduction of operating costs. Fuel is one of the biggest operating costs. Operating the engine more efficiently will reduce fuel costs. Controls help reduce maintenance costs by closer monitoring of engine operation.

Automatic controls increase safety at a station. Each instrument continuously monitors only one variable. Whenever that variable goes off limits the control swings into action and makes a prearranged shutdown or alarm.

Solid-state system. Texas Eastern Transmission Corp. has undertaken the installation of a solid-state control system. The first step will involve a master station and three satellite stations. Eventually it will reach 128 satellite stations with a computer at the master station.

The initial system, being installed by Control Corp., will have the control center at Shreveport, La., while the three satellite stations will be located at Berne, Ohio, West Monroe, La., and Danville, Ky.

This is the information that will be transmitted from each satellite station and which will be logged periodically: Alarms, suction pressure, discharge pressure, number of compressors operating, number of compressors available, number of compressors unavailable, station maximum capacity, station electric power, and gas flow.

The dispatcher will enter his set points and control functions through thumb-wheel switches mounted on the console. Fig. 28. Prewired programers will be installed at each station and will communicate with the dispatch center through digital-transmitter-receivers over microwave channel.

System's function. Function of the Control Data 800 system will be to:

1. Transmit operational requirements concerning pressure and gas flow from the dispatch center to the satellite stations.
2. Provide continuous scanning of all pertinent data and controlled devices and to indicate off-normal or upset conditions through audio, visual, and logged methods.
3. Initiate station or system log hourly, on demand or during station upset.
4. Furnish interface compatible with digital computer in order to adapt future closed loop control and billing features.

Plastic grout. Several companies have gone in for the use of a plastic grout. Since it will bond tenaciously to either metal or concrete, it is regarded as a highly efficient patching material.

One company has grouted five engines with plastic grout, Ceilcote's 648, and reports successful results. This company is particularly attracted by its resistance to oil, the cause of many of its former problems. It has found too that, because of its high physical and impact strength, the plastic grout contributes to better alignment. Fig. 29.

Plastic grout is credited with several advantages over conventional materials. It is impervious to oil, settling increases its strength, it is faster hardening, it bonds to metal, it has higher physical and impact strength, and is resistant to most chemicals. Because of its unusual bonding ability, a job can be interrupted and resumed days later.

COLUMBIUM has a strong affinity to carbon and also acts as a ferrite former on the crystalline structure, thereby increasing yield and tensile properties. Fig. 1.

Columbium steel may be answer to need for improved, safer line pipe

As a steel additive, this element adds appreciably to tensile and yield strengths. It also reduces hardenability, a valuable adjunct to welding. And it has very little effect on the ductility as measured by elongation and reduction of area.

BY A. G. BARKOW
Superintendent, Inspection Department,
Natural Gas Pipeline Co. of America

A progress report...

HERE ARE DATA collected during an extended investigation of a columbium-additive line-pipe steel, labeled XC-60. Analysis of chemical and physical properties indicate that a columbium-bearing steel having the following properties will approach optimum desired properties for line-pipe use.

Carbon	0.26% max.
Manganese	1.30% max.
Columbium	0.05% max.
Yield point	60,000 psi. min.
Ultimate strength	78,000 psi. min.
Elongation	Same as API 5LX Gr. 52

Pipe fabrication presented no unusual difficulties. Hydrostatic destruction tests made to date resulted in 100% ductile shear-type failures. Field welding gave no difficulty except for a very minor change in welding technique.

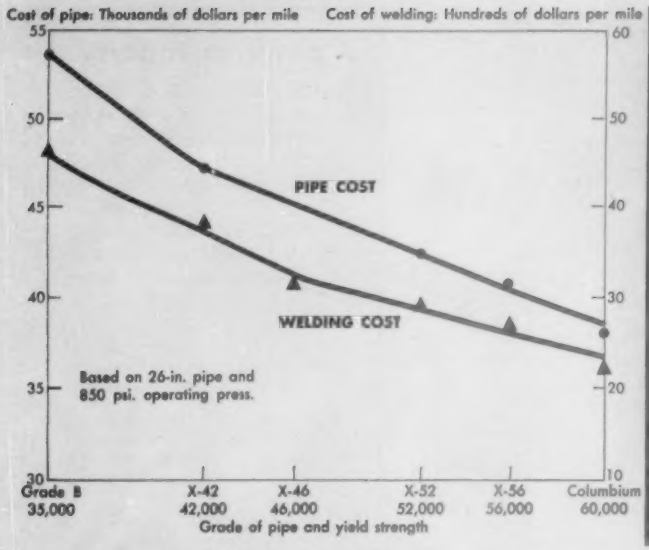
Field bending gave excellent results even in very light-wall pipe. Economic considerations are favorable to substantial savings.

The author states that his company has definitely adopted columbium steel 100%, and is using it on a 300-mile, 30-in. looping now starting.

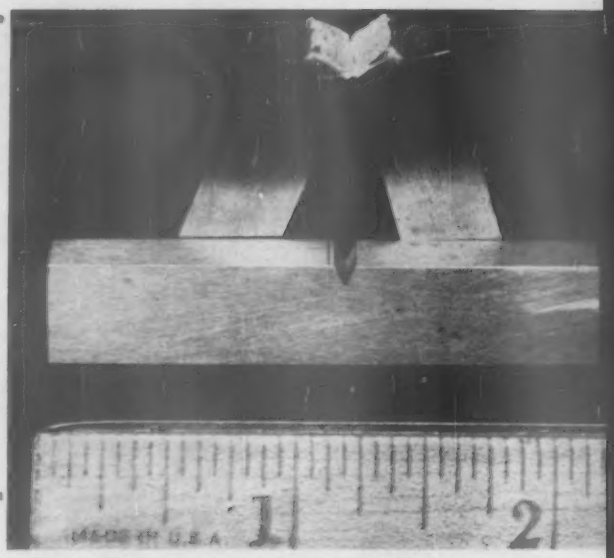
Barkow is chairman of the API-AGA Joint Committee on Oil and Gas Pipeline Welding Practices.

ECONOMIC PRESSURE as well as public safety demands have forced the pipeline industry to take a long look at presently available materials and investigate the possible development of new and improved materials which will fulfill this dual requirement. Larger and longer pipelines, operating at higher pressures, have demonstrated the economic feasibility of higher-strength material and the resulting lighter wall pipe, even where an alloying element may be necessary to achieve this purpose.

Basically, the need boils down to this: (1) a line-pipe steel which has a definitely higher yield and ultimate strength than is now available; (2) a steel which has notch toughness at lower operating and ambient temperatures; (3) a steel which is



THEORETICAL COST COMPARISONS of building pipelines with the columbium alloy pipe. It is indicated that the higher price of the steel will be outweighed by the benefits. Fig. 2.



SINCE TRANSITION TEMPERATURE was one of the factors in the investigation, complete series of V-notch impact tests were made of each heat in the as-rolled condition and as finished pipe. Fig. 3.

weldable, without preheat, at ambient temperatures lower than can be safely worked under present conditions; and (4) a steel which will have a lower per foot cost than present steels offered to satisfy such advanced designs.

In an effort to advance the science of line-pipe fabrication a joint venture in the development of such a line pipe steel was started about 2 years ago by Natural Gas Pipeline Co. of America, Great Lakes Steel Corp. and A. O. Smith Corp. and with the cooperation of H. C. Price Co., which conducted many of the field welding and performance tests. The steel developed for this purpose was based on the then-available Great Lakes GLX series of high-strength steels. This was a columbium-treated steel, having many of the desirable properties sought in the proposed type of line-pipe material.

Columbium as an additive to steel has a strong affinity to carbon and also acts as a ferrite former on the crystalline structure of the steel (Fig. 1). This tends to form a finer-grain structure thereby increasing to a higher value the yield and tensile properties. The carbide - forming tendency of this element is so strong that it frequently is in the structure as an undissolved carbide and in this way reduces hardenability of the steel, a valuable adjunct to weldability. At the same time it has very little effect on the ductility as measured by elongation and reduction of area. Taking into consideration these benefits, it is possible to decrease the carbon content without lowering the strength of the material. Since Columbium has no detrimental effect on weldability, the decrease in carbon produces a more weldable material in the high-strength group.

The basic ladle analysis and physical properties of the pipe set as a goal for this development were as follows:

Chemical:
- Carbon—0.26% max.
- Manganese—1.30% max.
- Columbium—0.05% max.

Physical:
- Yield strength: 60,000 psi. min.
- Ultimate strength: 78,000 psi. min.
- Elongation in 2 in.: Same as API 5LX for Grade X52 pipe steel.

This report is issued to bring to the industry the results of our findings in working with a columbium-additive steel labeled, for our purpose, XC-60. In presenting the following data, we consider this as a progress report with results that are highly encouraging and gratifying. The test program included investigations of steel-mill and rolling practices, pipe fabrication, production and testing, welding, bending, laying, and actual gas - transmission service. Studies of metallurgical and physical properties of the steel during the various stages of production and testing were made throughout the program.

Economics. The test program has produced results which indicate that the columbium-additive steel is a material suitable for pipeline application.

"Is this material commercially economical?" We have found that a higher design strength can be utilized with complete safety. This means that a lighter-wall pipe can be used. Consequently, a savings in steel tonnage will be realized; also a savings in freight can be figured. The lighter-wall pipe will cost less to weld and to handle in the field. It is indicated that the higher price of this steel will be outweighed by the benefits, thus giving a real economic advantage as well as a theoretical advantage. Fig. 2.

Material. The first experimental pipe made in this program consisted of 24-in.-o.d. by 0.250-in. wall and 24-in.-o.d. by 0.218-in. wall. The second phase consisted of the production and laying of 24-in.-o.d. by 0.250-in.-o.d. wall and 30-in.-o.d. by 0.312-in.-wall pipe. The third phase consisted of the production and laying of 47 miles of 20-in.-o.d. by 0.250-in.-wall pipe. During the second phase of the program, 4.25 miles of 24-in. pipe and 1.75 miles of 30-in. pipe were installed into an operating pipeline.

During the first phase, six heats

of steel were made using various chemical compositions and combinations to permit the determination of the best range of composition for future work. Table 1 shows the chemical and physical range of these heats in the "as rolled" condition.

Plate for the fabrication of pipe was selected from two of the above heats of steel, one with chemistry on high side. Table 2 shows chemical and physical results on expanded pipe made from these plates.

The second phase in this development program consisted in making production runs on two sizes of pipe—24-in.-o.d. by 0.250-in.-wall and 30-in.-o.d. by 0.312-in.-wall. The plate was made at two mills using slightly different techniques to arrive at the same end results. Six heats of steel were used in making 4½ miles of 24-in. pipe and five heats were used in making 1½ miles of the 30-in. pipe.

The chemical and physical properties of the expanded 24-in. and 30-in. pipe were as shown in Table 3.

Since the transition temperature was one of the factors in this investigation, complete series of charpy V-notch impact tests, Fig. 3, were

TABLE 1
Range of Chemical Ladle Analysis and Physical Properties of Plate as Rolled of First Six Heats

Chemical:
- Carbon, 0.19-0.27%
- Manganese, 0.81-1.30%
- Phosphorus, 0.009-0.013%
- Sulfur, 0.020-0.026%
- Columbium, 0.023-0.032%

Physical:
- Yield strength, 59,000-71,000 psi.
- Ultimate strength, 79,000-101,000 psi.
- Elongation in 2 in.: 30-38%
- Transition temp.:
  - 10 ft./lb., (−20° F.) to (−60° F.)
  - 50% shear, (0° F.) to (−40° F.)

(Note: All physical properties reported are in the transverse direction unless otherwise noted. All impact specimens are one-half size.)

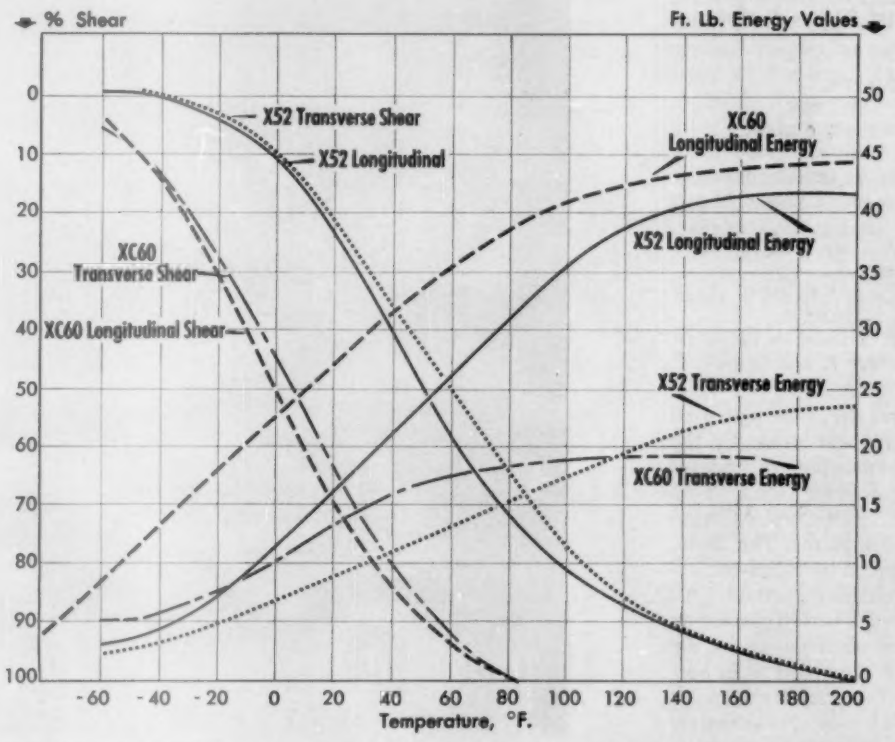
TABLE 2
Chemical and Physical Properties of Expanded Pipe

Chemical:
- Carbon, 0.23-0.26%
- Manganese, 1.22-1.30%
- Columbium, 0.019-0.030%

Physical:
- Yield strength, 62,000-70,000 psi.
- Ultimate strength, 83,000-96,000 psi.
- Elongation in 2 in., 26.0-32.0%
- Transition temp., 50% shear (−24° F.) to (+16° F.)

TABLE 3—CHEMICAL AND PHYSICAL PROPERTIES OF FIRST PIPE RUN

	24 in.	30 in.
Chemical:		
Carbon	0.21-0.27%	0.20-0.27%
Manganese	1.04-1.18%	0.89-1.20%
Columbium	0.030-0.039%	0.005-0.008%
Physical:		
Yield point	67,700-72,500 psi.	62,500-70,100 psi.
Ultimate strength	86,500-93,500 psi.	78,300-95,200 psi.
Elongation 2 in.	26.0-27.5%	28.0-32.0%
Trans. temp. (50% shear)	(−14° F.) to (+32° F.) Average (+15.5° F.)	(+12° F.) to (+31° F.) Average (+21° F.)



GRAPHIC COMPARISON of the charpy impact values of columbium-treated steels and the presently used grade X-52 steels. Fig. 4.

made of each heat in the as-rolled condition and as finished pipe. Both energy absorption and "per cent shear" were used as criteria in reporting these results.

It is the author's opinion that per cent shear is the better criteria for this work. Average results are included in each physical property table.

As a matter of comparison, with steels presently used in pipelines, the 50% shear transition temperatures range of approximately 200 heats of grade X-52 steel was from 20° to 90° F. with an average of 62° F. Two specimens were below 30° F. and four below 40° F. In contrast, 36 specimens were above 70° F. and 5 were above 80° F. Fig. 4 is a graphic comparison of the charpy impact values of columbium treated steels and the presently used grade X-52 steels.

The third phase of this program was an actual production run of 47 miles of 20-in.-o.d. by 0.250-in.-wall columbian-treated expanded pipe. Sixty-two heats of steel were used for the production of this pipe. Table 4 shows the chemical and physical range of this run of pipe.

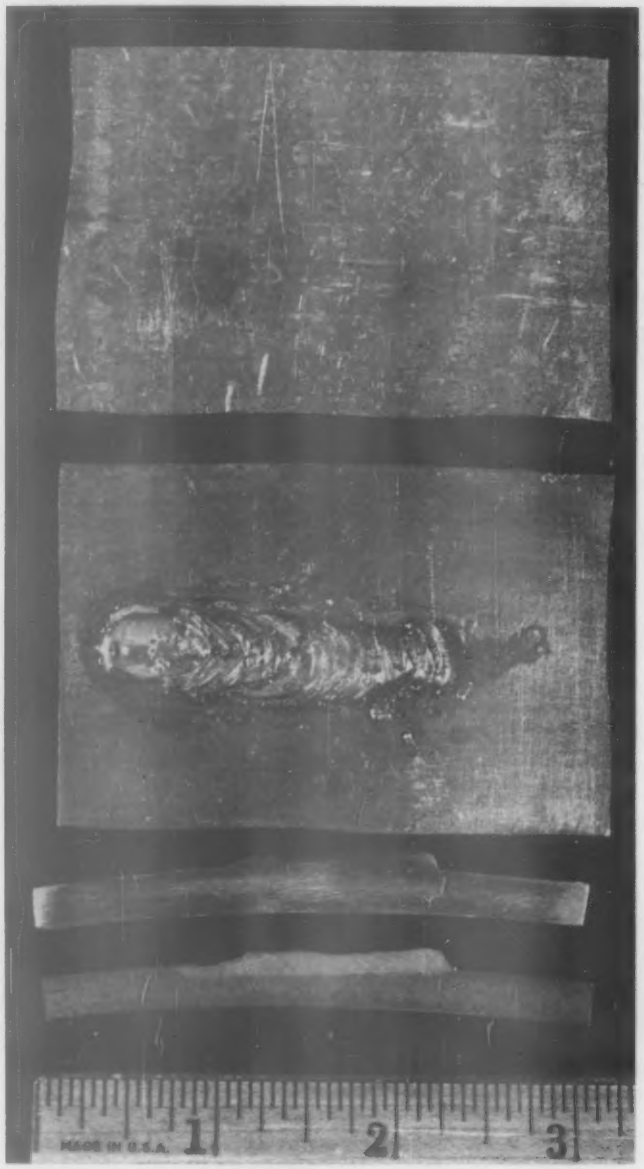
TABLE 4
Chemical Check Analysis and Physical Properties of 20-in.-o.d. Pipe

Chemical:
Carbon, 0.20-0.27%
Manganese, 0.89-1.28%
Columbian, 0.006%-0.018%
Physical:
Yield strength, 65,000-83,000 psi.
Ultimate strength, 82,000-101,000 psi.
Elongation in 2 in.: 22.0-32.0%
Transition temp.:
(−34° F.)-(+50° F.) (50% shear)
Average (+20.0° F.)
Five heats 50% shear at below 0° F., 9 specimens 40° F. and above

Manufacture. All of the pipe used in this program was made by the same manufacturing procedures used for flash-welded Grade X-52 pipe at A. O. Smith Corp. Milwaukee and Houston plants. The 24-in. pipe was expanded by either the hydraulic or mechanical methods. All 30 and 20-in. pipe was expanded by the mechanical methods. Using the same degree of expansion as in normal practice, the effective increase in yield strength was approximately 5,000 psi. for the XC-60 grade as compared to approximately 10,000 psi. for the X-52 grades. No difficulties were encountered in forming or in welding. All pipe was hydrostatically tested to 90% of minimum specified yield for a fiber stress of 54,000 psi.

Five burst tests were made on 24-in. diameter pipe during the first phase of testing. Three of the tests were made on full 40-ft. lengths and two were made on two 20-ft. sections with a girth weld in the center for an over-all length of 40 ft. each. In all cases, the burst was of a ductile 100% shear with an average length of rupture of 5 ft. The failure occurred in the plate material at yield and ultimate stresses in close agreement with laboratory strip tensile tests results and substantially above the minimum specified. These tests were made at an ambient temperature range of 30° to 40° F.

During the second phase, three 24-in.-o.d. and three 30-in.-o.d. pipes were subjected to hydrostatic destruction tests. Results of these



UNDERBEAD CRACKING-TEST SPECIMENS. Top, plate sample. Center, as welded. Bottom, as sectioned and examined. Fig. 5.

tests again closely agreed with strip tensile test reports. All ruptures were approximately 5 ft. in length in the plate material and showed 100% ductile shear fracture.

During the third run of 20-in.-o.d. pipe, two burst tests were made on 40-ft. lengths of pipe. Both ruptures approximately 5 ft. in length were 100% ductile shear fracture and the failure stress was in full agreement with strip tensile test reports. Table 5 shows the comparison of laboratory reports and actual hydrostatic stresses developed.

Test No. 1 of this group developed the highest strength at failure in this program. Test No. 2 was about average for all groups.

Relative Tendency to Underbead Cracking of Pipeline Steels as tested in Laboratory for Comparison Purposes*

Material—	Thickness inches	Number of specimens	Room	Per cent of cracking — avg. 40° F.	0° F.
5LX52	0.344	30	0	2	2.5
5LX52	0.500	30	0	2.5	0
5LX56	0.406	36	14	22	27
†XC-60	0.250	60	0	0	0
†XC-60	0.218	60	0	0	0

*Quoted from Battelle Memorial Institute Report on A Study of Underbead Crack Sensitivity and Notch Toughness of Steel for Welding Fittings for Pipe Lines.—"The bead-weld coupon test is a rather severe test and steels exhibiting less than 50% cracking in this test rarely crack in full-size girth widths." †XC-60 specimens were also examined under 50x magnification—no cracks were found in any test group.

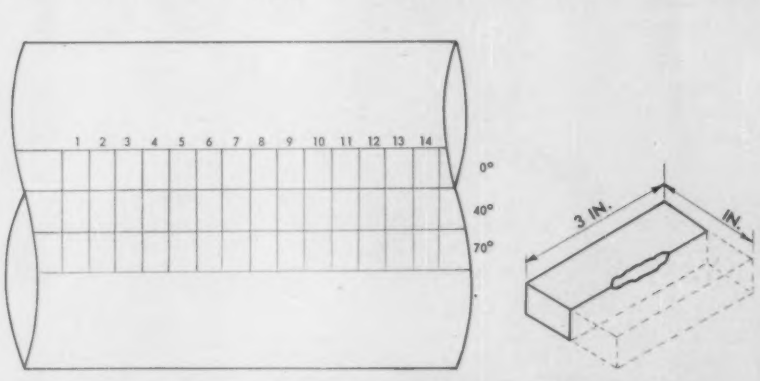
Welding Tests

Battelle underbead cracking tests. As a first step in the weldability test program for this material, a series of specimens were prepared in conformity with the Battelle underbead cracking test, Fig. 5, described in "A Study of Underbead Crack Sensitivity and Notch Toughness of Steel for Welding Fittings for Pipe Lines" by H. W. Mishler, R. P. Sopher, and P. J. Rieppel.

This test is primarily a bead-on-plate test in which a high state of stresses is introduced on the surface of the plate. Specimens were taken from sections of the four pipes joined by girth welds for the burst tests as mentioned above. Each pipe was from a different heat of steel. Two sections were 24-in.-o.d. by 0.250-in.-wall and the other two sections were 24-in.-o.d. by 0.218-in.-wall. The specimens were saw cut from the pipe sections as shown in Fig. 6. The specimens were 2 in. wide and 3 in. long. Initial plate temperature during welding tests were 0° F., 40° F., and room (70° F.) Ten specimens were used for each test-temperature level. All specimens were held at the specified test temperature for 10 hours before the start of welding. A control specimen was used for each test group to measure temperature rise during welding time.

TABLE 5—BURST TEST DATA FOR 20-IN.-O.D. PIPE

	Strip tensile laboratory yield pt. (psi.)	Burst test 2% off-set yield pt. (psi.)	Laboratory ultimate str. (psi.)	Burst test actual Ultm. str. (psi.)
Test No. 1	80,700	81,600	100,300	99,000
Test No. 2	67,300	67,200	84,700	81,000

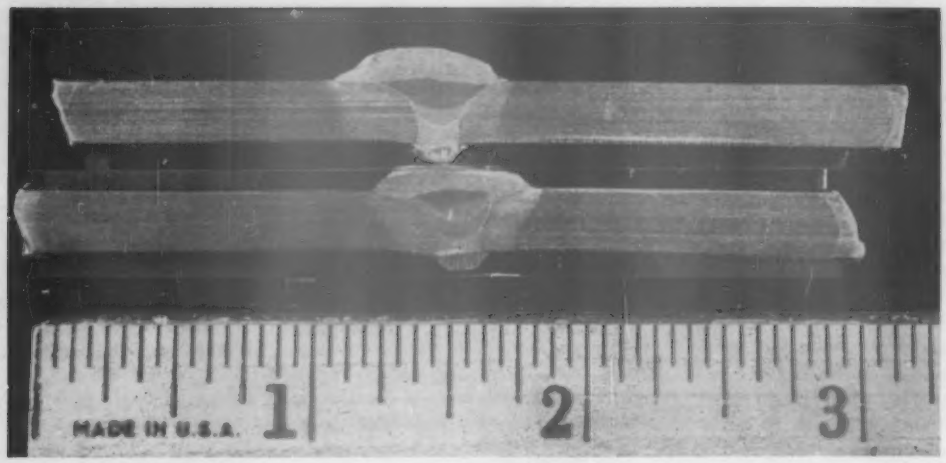


UNDERBEAD cracking-test specimens were saw cut from pipe sections. Ten specimens were used for each temperature level. Fig. 6.

The test welds were 1¼ in. long, welded in 7½ seconds, using ⅛-in. electrodes conforming to AWS specification E6010. After welding, the specimens were allowed to stand at room temperature for 24 hours and were then normalized at 1,650° F. for 1 hour. Each specimen was sectioned longitudinally through the center of the weld and polished to 260 grit, care being taken to prevent heating of the specimen during cutting and polishing. The polished surface was lightly etched and examined under 50x magnification. Each specimen surface was also examined by fluorescent magnetic-particle inspection to detect any trace of cracking. No signs of underbead cracking were found by either method of examination. Table 6 compares the results of these tests with similar tests on other pipeline materials.

Field welding tests. An extensive program of field welding tests was conducted at a pipeline-construction location, using pipeline welders provided by H. C. Price Co. and under varied field welding conditions. Four series of four welds each were made at temperatures ranging from −25° to +85° F. Pipe nipples for these tests were taken from the same pipe mentioned previously as having been welded together for burst tests. The subzero tests were made in a refrigerator railroad car, mechanically cooled to the desired temperature.

Pipe nipples were machine beveled to 30° with a land of 1/16 in. A 1/16-in. root spacing was also used. The nipples were matched and tack welded before cold storage. Since no power internal clamp was available, a greater than desirable



TENSION AND BEND TESTS were carried out on macrospecimens in accordance with API Standard 1104. Fig. 7.

amount of offset was encountered.

Welds were made using standard pipeline-welding technique. The root pass was made with either ⅛ or 5/32-in. diameter E6010 electrodes. The second pass with 5/32-in.-diameter or 3/16-in.-diameter electrodes and occasionally a 5/32-in.-diameter electrode stripper pass. The cover pass was made with 3/16-in.-diameter E6010 electrode.

The root passes were made at approximately 180 amp. and 28 volts, while the remaining passes were made with 200 amp. and 30 volts.

All welds were made in a horizontal stationary position, welding in a downhill direction and alternating in opposite quarters. Pipe was in cold storage for at least 18 hours before the test welds were made. No preheat was used. Test nipples were again left to stand in cold storage after completion of the test.

Four test welds were also made by an automatic submerged arc welding process. These were made at ambient temperature ranges of 25° to 35° F. with very high humidity prevailing throughout the test period.

The pipe was rotated in the submerged welding process and all welding was at a point near top center. The bevel was ground to leave a flat land of three-fourths of the wall thickness. Two passes were applied from the outside and one from the inside. Welding speed for the first pass was 90 in. per minute, using 800 amp. and 36 volts. The second pass was run at 65 in. per minute, using 700 amp. and 32 volts. The inside pass was made at 50 in. per minute, using 500 amp. and 34 volts.

The wire and flux used was compatible with the E7010 deposit specification. All welds were sectioned to yield from each quarter two tension specimens, one face bend specimen, one root bend specimen, and twenty-five ½-in.-wide macro specimens. Tension and bend tests were prepared and tested in accordance with API Standard 1104. Each of

TABLE 7—WELDING TECHNIQUE FOR MANUAL WELDS

Weld No.	Temp. °F.	Fleetweld No. 5 (E6010) first pass	Shield arc No. 85 (E7010) second pass	Shield arc No. 85 (E7010) Third pass	Fleetweld No. 5 (E6010) fourth pass	Remarks—
A 15	−15	1/8 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	Pipe in cold storage 24 hours before start of test welding and 24 hours after completion of weld.
B 15	+ 4	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
C 15	− 4	1/8 in. Fl 5	5/32 in. Sh 85	5/32 in. Sh 85	3/16 in. Fl 5	
D 15	−10	1/8 in. Fl 5	5/32 in. Sh 85		3/16 in. Fl 5	
A 0	+ 1	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	Pipe in cold storage 18 hours before start of test welding and 6 hours after completion.
B 0	−20	1/8 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
C 0	−10	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
D 0	− 3	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
A 30	+35	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	Pipe in cold storage 18 hours before welding.
B 30	+25	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
C 30	+50	5/32 in. Fl 5	5/32 in. Sh 85	5/32 in. Sh 85	3/16 in. Fl 5	
D 30	+15	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
A 70	80	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
B 70	85	5/32 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
C 70	72	1/8 in. Fl 5	5/32 in. Sh 85	3/16 in. Sh 85	3/16 in. Fl 5	
D 70	75	5/32 in. Fl 5	5/32 in. Sh 85	5/32 in. Sh 85	3/16 in. Fl 5	

One welder was used on each weld except the "0" series. Average welding time was 1 hour, 20 minutes.

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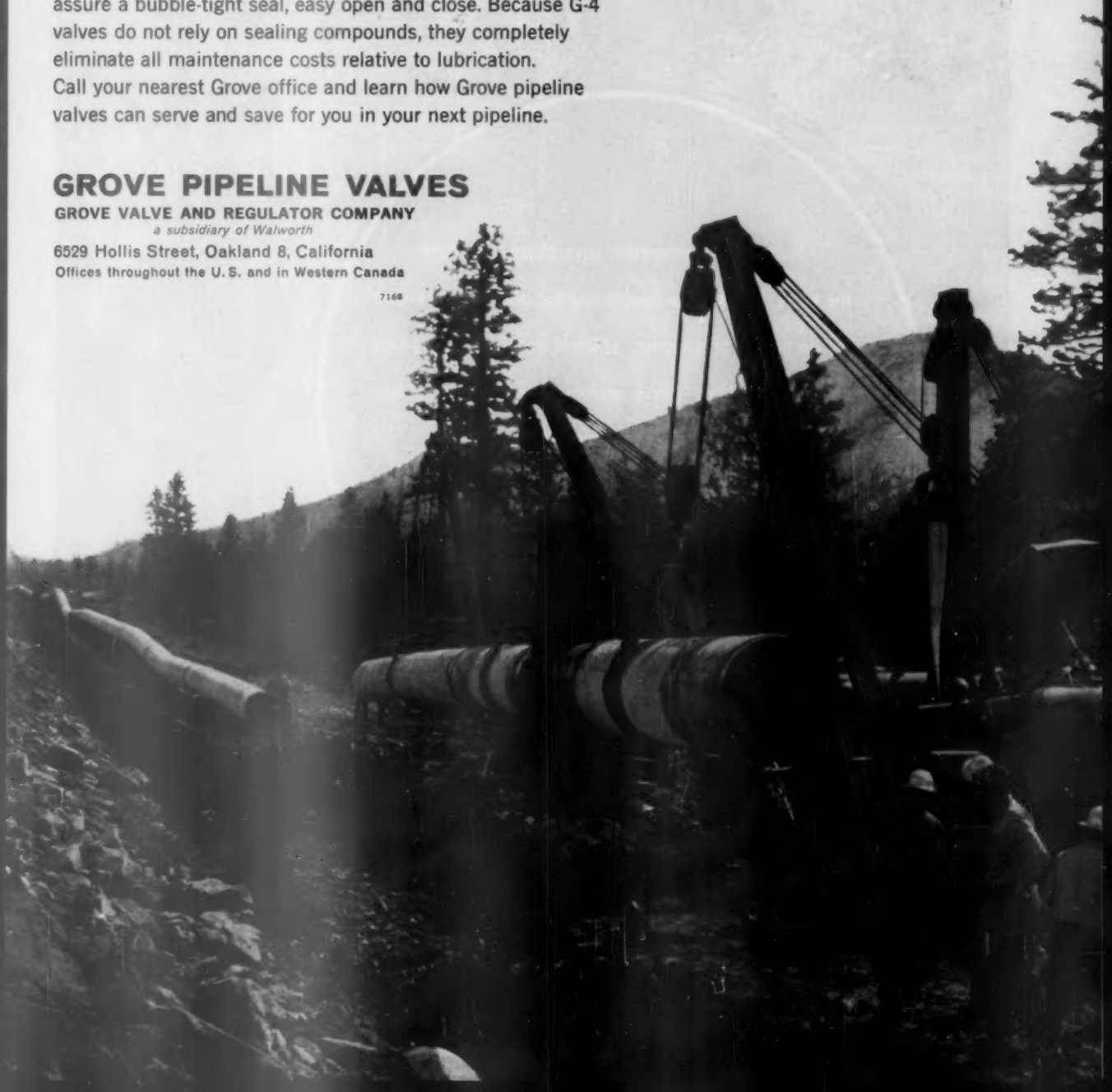

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TABLE 8—PHYSICAL PROPERTIES OF FIELD WELDS

		Yield strength	Ultimate strength	Rockwell stock	"B" hdn. weld
Manual	High	80,000	98,750	105	95
	Low	72,250	87,750	75	80
	Avg.	75,600	94,300	89	88
Automatic	High	86,600	105,200	98	95
	Low	74,000	92,200	73	85
	Avg.	82,000	100,000	90	91

the macro specimens was examined under 50x magnification. Two macro specimens from each quarter were also subjected to Rockwell hardness tests.

The average results of the tension tests are tabulated as shown in Table 8.

Although the physical properties in all tests were well within the expected range, a number of tensile specimens failed in the weld area, some of which showed shallow cracks in the root area. In almost every case of failure, the adjacent root bend also failed, again revealing minute cracks. This was the most disturbing factor of the entire test. While defects were slightly more prevalent in the welds made at low temperature, sufficient numbers were found in the welds made at higher temperatures to indicate that this was a matter of welding technique rather than of material characteristic.

Examination of the macro-etched specimens under 50x magnification again showed the cracks and also gave information on both the origin of the cracks and the distribution. Frequency of occurrence followed no pattern which might indicate that atmospheric or base-metal temperature was a factor. Furthermore, the majority of the cracks were almost microscopic in nature, being less than ½ in. long and 0.05 in. deep. Practically all cracks started in a weld defect with integral undercut, lack of complete penetration, and offset welds accounting for most of the offending defects. Many of the cracks starting in internal undercut, followed the edge of the weld or were in the heat-affected zone.

To further study this condition as a weldability problem of this material under field welding conditions, a second set of 10 welds was made using electrodes supplied by 3 different manufacturers. Two types of electrodes conforming to AWS-E6010 and E7010 were used in these test welds. Welding heat and welding speed was approximately the same as in the first set of test welds, but somewhat greater care was taken in the welding. The test welds were again sectioned as before and the same type and number of tests were made. Table 9 shows physical results of these tests.

One weld gave very poor results because of an extremely bad mismatch of weld edges. All other welds gave satisfactory results on location of fracture in tension tests and all passed root and face bend tests. The X-52 welds were also of good quality, but did have more specimen failures, possibly due to a greater number of defects in the welds.

Further study of welding technique was felt necessary before the material was ready for use. The outstanding difference in weldability characteristic between the columbium steel and the X-52 grade steels was the greater fluidity of the welding puddle in the XC-60 steel. By reducing the welding heat for all passes, particularly the root pass, and by closing the root gap to about 1/32 in., it was found that internal undercutting and lack of penetration could be eliminated and a good internal bead produced with an even flow into the parent metal on both sides of the bead.

Using this new welding technique, the first 24-in.-o.d. by 0.250-in.-wall pipe and 30-in.-o.d. by 0.312-in.-wall pipe was installed with complete welding success. Further, a 47-mile line of 20-in. by 0.250-in.-wall line was installed without the loss of a single weld through cracking. It is therefore felt that this material can be welded without trouble and without danger of cracking, provided it is remembered that the material "welds like a mild "steel."

Field bending. The last phase of field testing of this material concerned itself with cold bending by conventional methods. Four lengths of 24-in.-o.d. pipe from the original rolling were used for these tests. Before starting the bending tests, thickness readings were taken at both ends of each length. The average of 10 readings gave the following results:

Pipe	Wall thickness, in. East end	Wall thickness, in. West end
A	0.234	0.233
B	0.234	0.238
C	0.204	0.204
D	0.226	0.223

Each of the pipes was bent to failure by buckling. Pipe A was pulled ½° set on 1-ft. centers to 8½° with a smooth bend and no buckle. A slight buckle occurred after several pulls to ¾° set. Pipe B was pulled to ½° set per 1-ft. centers, with several pulls made to ¾° set. A smooth bend of 14° total was achieved in 21 pulls. Pipe C had the thinnest wall of all pipe tested, 24-in.-o.d. by 0.204-in.-wall and several successful pulls were made at ½° set and 18-in. centers, but a slight buckle at this point indicated this to be the top limit for good bending. A pull to ¾° set buckled pipe. A smooth buckle-free bend was achieved with ⅓° set at 1-ft. centers.

Analyzing the pulling and bending of this pipe, it was concluded

TABLE 9—PHYSICAL RESULTS OF SECOND TEST WELDS

		Yield strength	Ultimate strength	% elongation
XC-60	High	70,600	90,000	29.5
	Low	62,400	81,900	28.5
	Avg.	66,000	85,500	29.00
X-52	High	59,400	85,800	32.0
	Low	56,600	81,300	30.6
	Avg.	58,000	84,000	31.0

TABLE 10—MAXIMUM DIFFERENCE BETWEEN DIAMETERS AFTER BENDING

Pipe	East end	First bend	Second bend	West bend
A	0.464 in.	0.719 in.	0.552 in.	0.499 in.
B	0.216 in.	0.313 in.	0.459 in.	0.496 in.
C	0.603 in.	0.218 in.	0.420 in.	0.390 in.
D	0.298 in.	0.372 in.	0.732 in.	0.123 in.

TABLE 11—RESULTS OF FIELD TENSION TESTS AFTER BENDING

Specimen No.	Yield strength	Ultimate strength	Elongation % in 2 in.
A E	85,400	105,600	27.0
B E	80,600	102,200	27.0
C E	70,700	94,250	28.5
D E	70,700	93,350	30.0
AOR	89,475	102,100	25.5
BOR	91,750	105,220	25.7
COR	80,020	99,800	26.0
DOR	77,000	94,800	28.0
AIR	82,400	105,375	23.5
BIR	79,900	102,275	28.0
CIR	70,050	97,050	27.2
DIR	73,075	92,425	28.0

E = End. OR = Outside Radius. IR = Inside Radius.

that a greater pull was required to effect the initial set and that each pull had to be a greater arc to effect the desired set due to the "springback" or return to the original straight pipe. It was also found that a buckle will appear more rapidly and more severely if the limit of pull is exceeded, but that with the right amount of pull, the set will be smooth and the final completed bend will be without measurable signs of waves.

Audigage thickness readings taken before and after the bends were made gave such close results that no determination of thickness change could be detected. Diameter readings were also made before and after the bending. These readings were taken in four planes at the ends of the pipe and in the center of each bend. Table 10 gives results of these tests.

The erratic results of these measurements do not lend themselves to an analysis. The indications are that a change in diameter or ovality of approximately 0.250 to 0.500 in. occurred in this bending test. It was concluded that bending could be satisfactorily done with field bending equipment and in a length of radius that would be entirely satisfactory. Later experience substantiated this conclusion.

To check the effect of cold working due to the bending, tensile specimens were taken from the ends, outside radius and inside radius of bends of each pipe. The tension tests were taken in a longitudinal direction, since the working effect of the material was in this direction. Table 11 gives results based on an average of four specimens each.

Examination of this table shows a gain in yield strength at the outside radius of approximately 8,000 psi. and no perceptible gain in ultimate strength. At the inside radius a gain of approximately 1,500 psi. in yield strength was noted with no gain in ultimate strength. A reduction in ductility of approximately 2% was noted for both outside and inside radii. These figures would be in line with gain in cold expanding in the fabrication of the pipe where a similar degree of cold work is applied.

CHECKING TOLERANCES on 30-in.-o.d. XL-60 pipe bend.

General Laying Practice

Based on the results of these tests, approval was obtained to include 4½ miles of 24-in.-o.d. by 0.250-in.-wall pipe and 1½ miles of 30-in.-o.d. by 0.312-in.-wall pipe in the 1960 construction program. Both of these sections were in relatively rolling country, necessitating numerous bends of various degrees. Both phases of these installations were carried out without difficulty of any sort. The welders were instructed on the characters of the material and reported no difficulty. In fact, the consensus was that columbium-treated steel was more readily weldable than the normal Grade X-52 pipe. Bending also presented no problems. Bending foremen recognized that greater springback was encountered, but also reported that the bends were more uniform and that they were well satisfied with the bends produced.

Early in 1961, a 20-in.-o.d. by 0.250-in.-wall pipeline of 47 miles was laid using columbium-treated steel throughout. Again, no difficulty was encountered. In the welding of this line, the stringer beads were cleaned by grinding. Radiographic inspection of approximately 40% of the welds showed this line to be probably the most devoid of weld defects of any line ever built. Only 4 welds were cut out because of defects out of 1900 radiographically inspected. No cracked welds were found. The line was pressure-tested without incident.

Acknowledgment

The writer acknowledges the cooperation and help received during this program from Great Lakes Steel Corp., W. D. MacDonnell, C. L. Altenburger, F. A. Bourke, and W. F. McGarrity; A. O. Smith Corp., H. Detrick, T. Creden, G. E. Fratcher and E. H. Uecker; H. C. Price Co., H. C. Price, A. Reutzel and B. Elliott; and Natural Gas Pipeline Co. of America, M. V. Burlingame, K. Bentz, D. C. Palm, M. J. Paul, J. E. Thompson, M. L. DeCraene, and M. M. Whitson. Appreciation is also expressed to the above-mentioned companies for permission to release these data to the industry. Finally, the writer acknowledges the help of welders, technicians, and associates in conducting the tests, preparing the specimens, and developing the data presented herewith.

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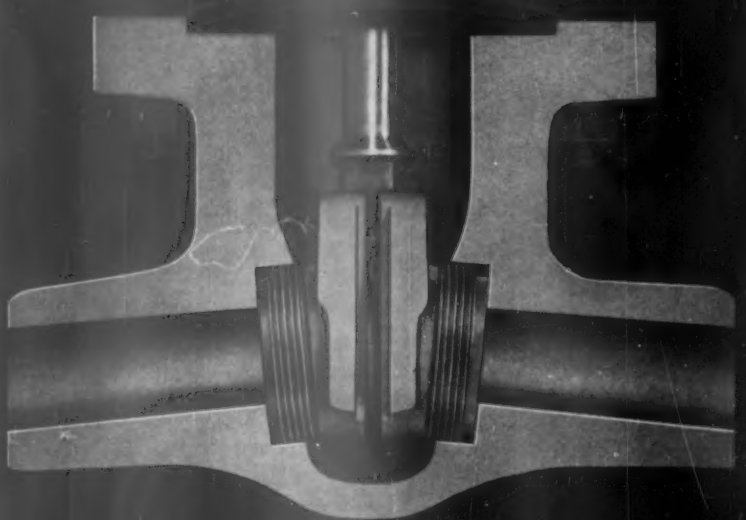

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LOWERING IN a section of 30-in. with five boom tractors at Majestic spread near a road crossing in Alberta.

Records topple in building '61's biggest pipeline project

Alberta-California line gives double jointing a real workout

BY PAUL REED
Pipeline Editor

WORK for laying 30 and 36-in. main-line pipe in Alberta and British Columbia has set new scores in pipelining. Spreads in Alberta have broken records for laying such large pipe. And in British Columbia the long 80-ft. joints have been aggressively laid over alpine mountains where difficulties seemed prohibitive. The whole Alberta-California project, of which this work is a part, has demonstrated, on the largest scale, what can be accomplished by extensive use of double joints. Results so far indicate that project costs are well within the construction budget.

Pacific Gas & Electric Co., the sponsors, and Bechtel Corp., together with Canadian Bechtel, Ltd., engineers and management - supervisors for the Alberta - California System, boldly departed from pipeline precedents. No previous major project had ever carried out such a program for large use of field plants and mills for doing double jointing and coating ahead of construction. This meant double jointing nearly all of the pipe for the main line from Alberta to the San Francisco area and plant-coating all the pipe beyond Alberta. Both PG&E and Bechtel have favored this policy because of what they had learned in years of experience. Now it is paying off on a big scale.

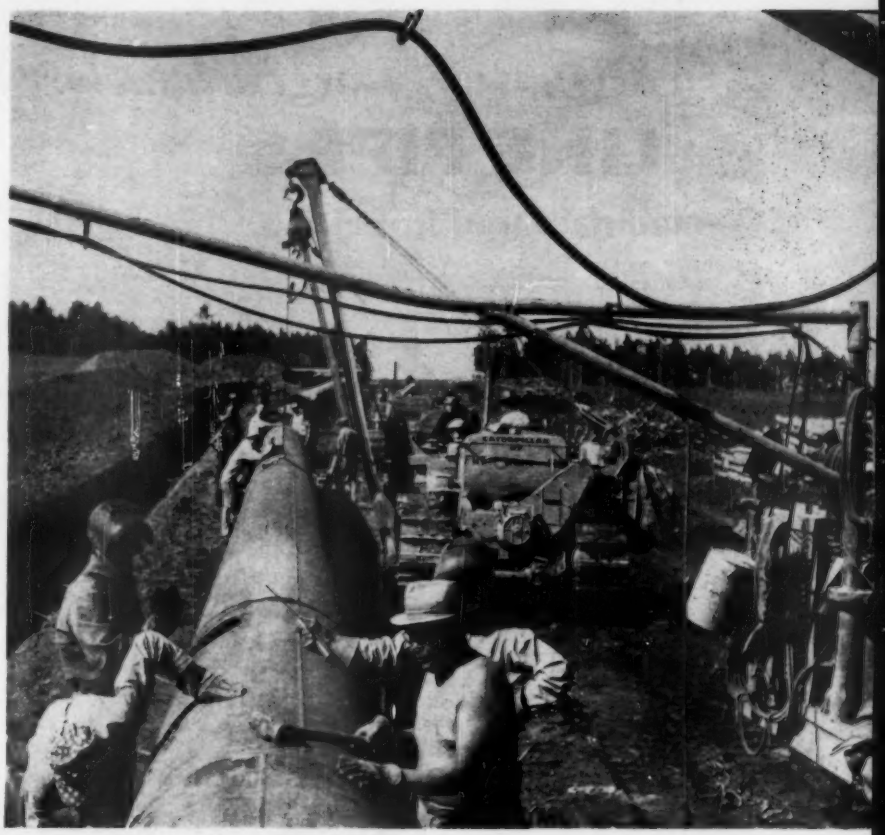
Pipe laying for the Alberta-California System will be completed this fall about a year after it was started.

Methods used in pipelaying are discussed in this article. During the summer, the writer visited spreads in Alberta and British Columbia. Early in the year he observed construction work in California and Oregon (OGJ, Mar. 13, 1961, p. 109).

Fast Pipe-Gang Progress

In the prairie country of Alberta, pipe-gang progress demonstrated that the long, heavy 80-ft. joints of 30 and 36-in. pipe can be laid with a daily footage averaging close to 10,000 ft. per day. At the end of June the Alberta Consolidated Pipeline Builders spread was reported

LINING UP and spacing just before four welders start on the stringer bead at Alberta Consolidated spread. Setting in and lineup can be done in about a minute in Alberta Prairie country.



to have laid a maximum of 15,200 ft. of 36-in. pipe in a single day in the Schedule 2 section in Southwest Alberta. In the same period Majestic Contractors, Ltd., had a high score of 17,800 ft. of 30-in. in a 10-hour day in Schedule 3. At that time Majestic had set a goal of 12,000 to 13,000 ft. daily output for this pipe gang. It had been reaching it quite regularly in the previous week or so. During the first month on this job daily footage for this spread had averaged 10,900 ft.

Actual clocking of a series of pipe-gang operations showed that joints were being added to the line at the rate of a joint every 2 minutes to 2 minutes and 10 to 20 seconds. Running the stringer bead took a minute to a minute and 10 seconds. Spacing and lineup time was 20 to 30 seconds and the setting-in tractor took approximately the same time to bring up the next joint to contact the line. These time observations, between the banging of one joint to the banging of the next one, indicated the gang's ability to meet the hourly objective of running stringer beads at the rate of 20 joints per hour (3 minutes per joint).

All of this was done under exacting specifications requiring that the inside lineup clamp be held in place through 100% of the time for running the stringer bead.

Stringer beads were run by four stringer welders in the Majestic and Alberta Consolidated spreads just cited. Majestic followed with four hot-pass welders and Alberta Consolidated with six hot-pass welders. Majestic's firing line had 24 to 25 welders.

All of the 30 and 36-in. mainline pipe was double jointed to make two 40-ft. joints into an 80-ft. joint, with the exception of 20 miles. This was a 20-mile stretch in the Livingstone Mountains where 40-ft. joints of 36-in. were used instead of 80-ft. joints. Dutton-Williams double jointed the pipe for Majestic and for its own section of 63 miles of 30-

BENT 80-FT. 36-IN. being carried down mountain slope for lining up by tractor snubbed by winch line from tractor above. This operation took 1½ hours in British Columbia Mountains.

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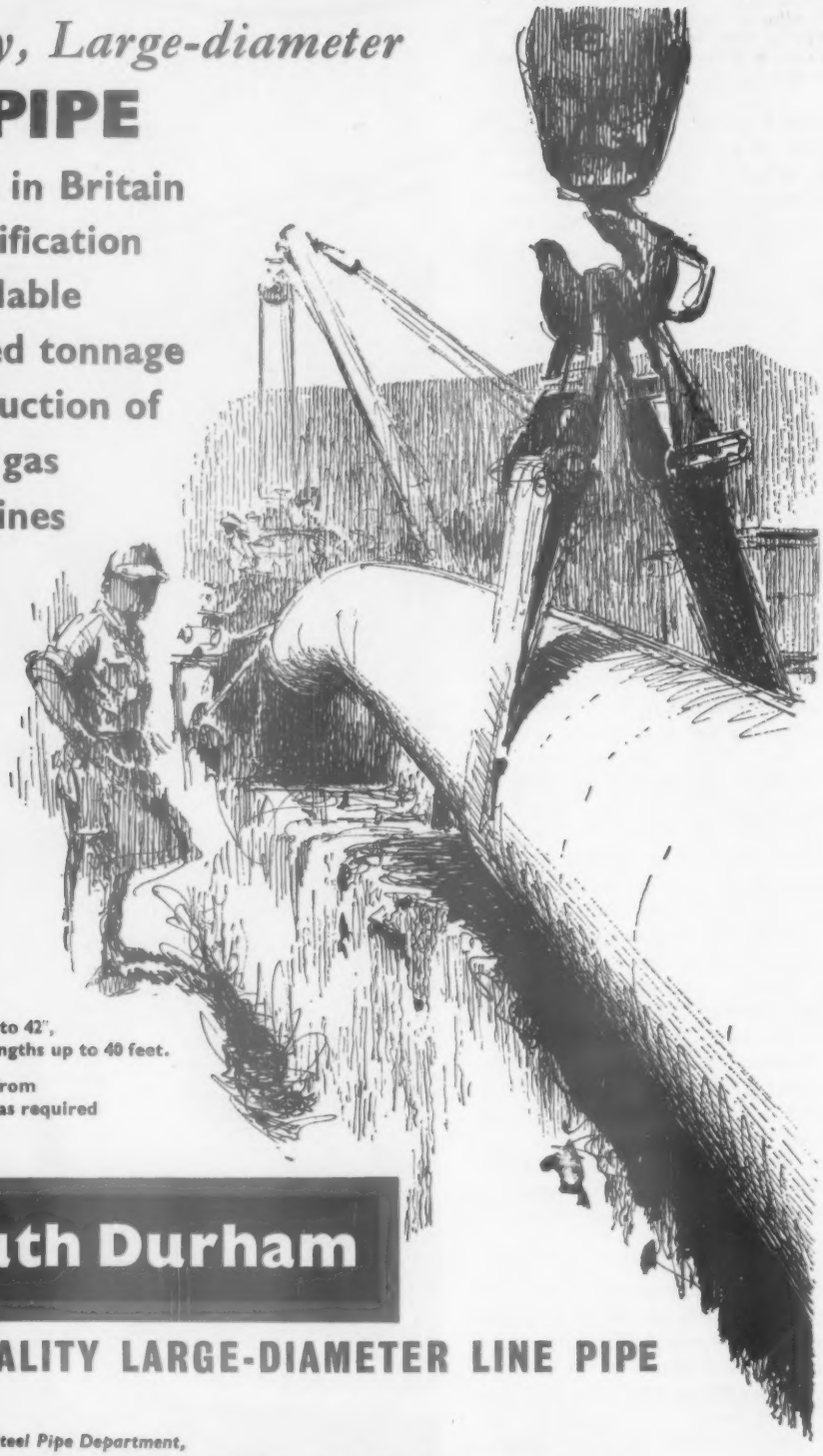

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TWO SETTING-IN TRACTORS and twin-arc tractor-mounted welding unit serving stringer-bead welders. This tows an Athey-wagon trailer carrying spare lineup clamp in a Majestic pipe gang.

in. main line and 18 miles of 22-in. lateral both in Schedule 4. Dutton-Williams used a Crose-Price-o-matic submerged arc unit which was moved from location to location at 35-mile intervals along the sections served.

The 36-in. pipe for Alberta Consolidated was double jointed by Banister Construction Co., Ltd., using a Cal-Metal single-arc submerged-arc fully automatic unit. Pipe was tack-welded manually. One pass was run on the outside and one inside.

The toughest part of the Alberta project was in the 18-mile, 22-in. lateral laid by Dutton-Williams in the northern end of the system. Tractors bogged down even on hilltops in the peculiar gravelly soil mixed with silt. Pipe was strung with Athey wagons. In such terrain only 2,900 ft. per day could be laid. Average progress for this 22-in. job as a whole, however, was about 6,100 ft. per day.

Most of the main line in Alberta goes across prairie country, some of it choppy. Much of it is flat and favorable for pipelining.

In the Livingstone Mountains at the southwestern border of Alberta, the line traverses 24 miles of rough, spectacular mountain terrain. It is all rocky. The worst of it is in the 17 miles at the furthest end. For 20 miles in this area, 40 ft. instead of 80-ft. joints were used. The long joints had been hard to manipulate in bending and lineup on the steep grades. Tractors would turn over.

Tow tractors had to be winched. Sometimes several hundred feet of winch line had to be used. Two tractors would have to dig in to hold where level spots could be found on the slopes. Sometimes there would be two tractors bunched together on a ledge or one would be put above another at different spots.

Although 2,000 to 3,000 ft. a day would be considered good going in such mountains, the spread at times showed it could produce 6,000 to 7,000 ft. a day there. Since this section was all rock, a large amount of dirt padding for the pipe was needed.

SHIELD held between two of the four stringer-bead welders working at close quarters on 36-in. pipe in Alberta.

SECTION OF 36-IN. PIPE being carried by four boom tractors in operations at one of several crossings of the Moyie River in British Columbia, laid by Price-Poole. (Photo courtesy Canadian Bechtel, Ltd.)

In the 107-mile, 36-in. section in British Columbia, Price-Poole Construction Co., Ltd., is working up from the southwest end to lay 87 miles while Mannix Co., Ltd., is going down from Crowsnest Pass to the Alberta border to lay 20 miles. All of the route is through and across the most rugged kind of alpine mountains, in an area where snow is frequently on mountain tops in the summer.

The pipeline route goes straight up steep mountain slopes and winds through river valleys. Price-Poole has been using 80-ft. joints throughout its British Columbia section. By September 1, 87 miles had been laid and the spread was well within sight of completion date of September 30.

Lineup and welding on the Price-Poole spread started May 20. By early July, average progress was reported as 6,400 ft. per day. The maximum day's output had been 8,000 ft.

Heavy snow, sometimes 20 ft. deep on the mountains, and high water in the spring delayed the Price-Poole operations. If the Moyie River had been low Price-Poole would have been able to reach the right-of-way by some available access roads. At best, access roads were few and therefore stringing trucks going along the right-of-way frequently interrupted welding.

Right-of-way work for this British Columbia section started November 1, 1960. Some river-crossing work was done during the winter at relatively low crossings and swamps. Through the winter pipe was double jointed, coated with asphalt, and wrapped at the Yahk, B. C., yard. Later double jointing and coating were done at McGillvray and Elko, B. C.

In the British Columbia section the amount of rock requiring shooting is only about 15%—much less than would be expected in such mountainous country.

The slope up Moyie Mountain from an elevation of 3,000 ft. at the bottom to 6,550 ft. at the top, is steep but not rough. From Kootenay River (elevation 2,300 ft.) the line goes over the top of Flathead Mountain (elevation on 7,200 ft.).

The spread has been held close together. In July it was sometimes not more than 3 miles from ditching to lowering in. Very little trench was dug by ditchers. Digging was done by nine back hoes and three clams. Welders included 3 for stringer beads, 4 for hot-pass, 12 on the firing line, 2 for fabrication, and 2 for tie in.

DOPE MACHINE applying asphalt enamel, porous glass-fiber inner wrap, and nonporous glass-fiber outer wrap.

Choosing *exactly* the right bearing can mean a vital difference in performance, cost and product life. That's why it pays to call Torrington first.

Torrington makes *every* basic type of anti-friction bearing . . . can advise you *impartially* on the best bearing for *your* application. Needle, roller or ball . . . you won't find finer bearings than Torrington. Specify with confidence. If you have a bearing problem, call or write us today. Send for catalog information.

1. Drawn Cup Needle Bearing. Maximum radial capacity in minimum cross section. Easily positioned by press fit. **2. Drawn Cup Roller Bearing.** Ample lubricant storage for smooth starting, cool running, extra-long service life. **3. Heavy Duty Roller Bearing.** Top bearing efficiency and long life under toughest shock conditions. **4. Roller Thrust Bearing.** Precision built for outstanding performance. Large Controlled Contour rollers for maximum capacity. **5. Self-Aligning Ball Bushing.** Low cost unit for top performance in rugged applications. **6. Spherical Roller Bearing Pillow Block.** High radial and thrust capacity. Fast, easy installation. Grease or oil-bath lubrication. **7. Needle Thrust Bearing.** Unequalled capacity for size and weight. Runs directly on hardened ground surfaces, or on standard thrust races. **8. Cam Follower.** Exceptional combination of high capacity, maximum toughness, dependable performance under shock loads. **9. Spherical Roller Bearing.** Precision engineered for maximum efficiency, optimum service life. Self-aligning.

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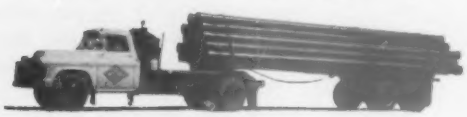
Tough, tested and ready to roll . . . that's the story in a nutshell on Lone Star casing, tubing and line pipe. Tough, because it's made of quality steel by men who know the needs of the oil country. Tested so carefully that every length of pipe meets or exceeds API requirements before it leaves our plant. And because we're located in the heart of the Mid-Continent producing area, Lone Star pipe can usually be on-the-job at your well site overnight.

Men in the saddle in the oil business know that Lone Star pipe is *dependable*.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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Clarence Shivel, spread superintendent for Price, flew over the spread every day in a helicopter.

Padding

For rocky country special attention has been given to padding the bottom of the ditch and shading the top of the pipe with fine dirt to protect the coating against damage from rocks or large gravel in the backfill. Dirt padding has been definitely specified and contractors have not been given the option of substituting a stiff rock shielding wrap. Such material, however, is used on the project under river and swamp weights.

Price-Poole used a padding machine for sifting padding material from the backfill. But most of the padding was hauled to the job. In sections of the project built by Pacific Gas Transmission Co. (Idaho, Washington, and Oregon) padding material was stockpiled during the winter in advance of later requirements. Except in the Livingstone Mountains little padding has been needed in the Alberta operations.

On Schedule 1 in southwestern Alberta, Majestic converted a ditching machine to padding service temporarily in one area. It used the "false ditch" method of digging fine dirt from a shallow ditch, only 2 ft. deep, on the working side of the main ditch. By means of a steel grid called "grizzly bars"—a mining and quarrying term — fine material is sifted, from the end of the ditcher's belt, so that it drops into the ditch. Rocks caught by the grizzly bars slide down by a chute into the false ditch.

Front-end loaders of the high-lift type were used for putting into the ditch the padding material that had been hauled in.

Small tractors of the kind that run along the bottom of the ditch to smooth the padding are being called kittens.

Padding Requirements

Where there is rock or gravel in the bottom of the ditch, specifications for the British Columbia section require that it shall be evenly padded with soil, sand, or other satisfactory material. Depth of padding must be sufficient to keep the pipe in place at least 4 in. from the rock or gravel. Rock, gravel, and similar materials are not allowed to be backfilled directly onto the pipe.

Enough earth or sand must be first backfilled around and over the pipe to form a protective padding or cushion. In this material no gravel or rock more than 1 in. in diameter is allowed. Material should be free of sharp "shot rock" and contain 75% of volume of fines so as to adequately fill all voids between gravel and rock pieces contained in the pad material.

Padding, shading, and backfilling standards, similar to these set for the British Columbia section, are also prescribed for the other sections.

The ditch is cut wide enough to allow the pipe to be 6 in. from the trench wall on each side and deep enough for minimum cover of 36-in.

Coating and Wrapping

In the building of the Alberta-California System, the practice of doing coating and wrapping at the spreads on the right-of-way is followed only in the Province of Alberta. There the line is built and owned by Alberta Gas Trunk Line Co., Ltd. The other sections of the line built by Alberta Natural Gas Co. (British Columbia), Pacific Gas Transmission Co. (Idaho, Washington, and Oregon) and by Pacific Gas & Electric Co. (California) use double-jointed pipe (80-ft. lengths) coated and wrapped internally and externally at mills or field plants. Pipe in the Alberta section is not internally coated.

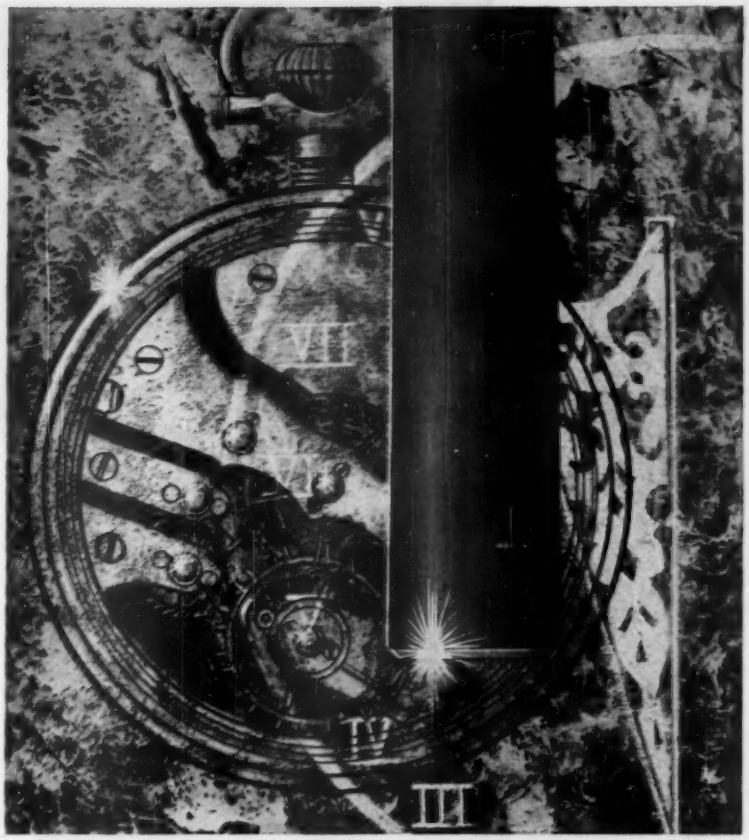
The practice generally followed is to have the pipe treated—this is the term used on the project—with single coat and single wrap using asphalt primer, asphalt enamel, porous glass-fiber innner wrap, and nonporous glass-fiber outer wrap impregnated with asphalt and mica. River crossings are treated with double coat and double outer wrap. There are exceptions in areas where Somastic has been applied—in certain parts of California.

Specifications for primer and enamel used on the Alberta-California System are as follows:

Asphalt primer (Ref. Asphalt Institute Specification M-1, Section 2.1—December 1958).

The primer, composed of a petroleum asphalt base and petroleum solvents, is blended to produce a liquid to be applied cold by brushing or spraying. It must meet the following requirements:

Flash point (Open Tag), °F. min.	100
Furol viscosity at 77° F., sec	30-150



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Products of proud craftsmanship, Lone Star casing, tubing and line pipe are formed from tough, high quality steel . . . then precision finished to meet exacting API requirements. Here is pipe so uniformly dependable that it has become the standard of comparison throughout the oil and gas industry. And Lone Star's location in the heart of the Mid-Continent oil producing area means faster delivery . . . on the double service that can usually put pipe on your location overnight. It pays to pick Lone Star!

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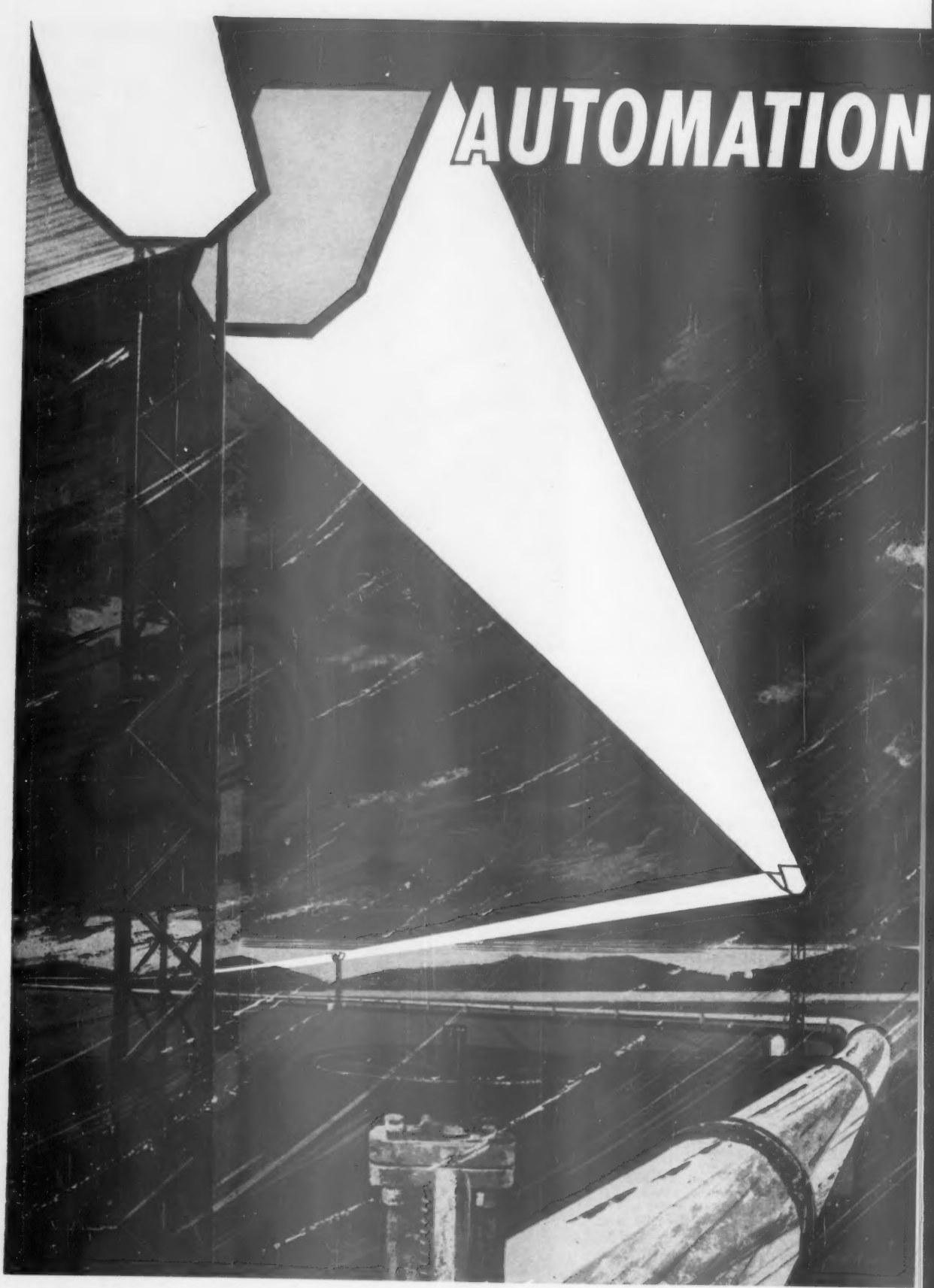
AUTOMATION



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It's no secret along the pipeline that Lenkurt Electric traditionally exercises rigid engineering disciplines in the design of microwave and carrier equipment —and imposes unusually high *system* reliability standards on all Lenkurt engineered microwave systems.

For instance, the self-imposed reliability standard of Lenkurt microwave is 99.99% per hop, because experience has proven lower standards will cost you more in the long run.

Any pipeline company with an eye to *reliable automation through communications* can draw some interesting conclusions from this:

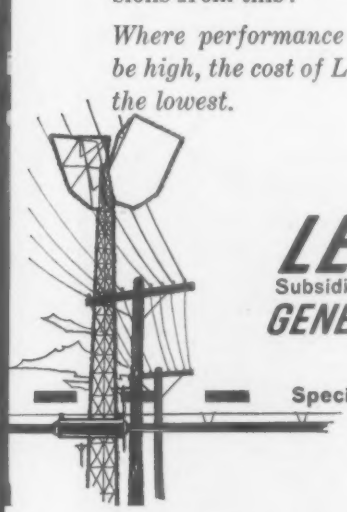
Where performance requirements must be high, the cost of Lenkurt equipment is the lowest.

Where life expectancy and reliability are measured in decades—as Lenkurt equipment and systems are—you always obtain the greatest returns on your original investment.

As a leading specialist in microwave and carrier, Lenkurt Electric is ready now to bring you *total* communications in one package—and handle the complete installation from start to finish.

For complete information about the advantages of dealing with Lenkurt Electric, contact the Lenkurt Electric office nearest you.

Lenkurt Electric Co., Inc., San Carlos, California. Offices in Atlanta, Chicago, Dallas, Minneapolis, New York and San Carlos.



LENKURT ELECTRIC

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GENERAL SYSTEM

Specialists in **VIDEO, VOICE and DATA TRANSMISSION**

Distillation:	
Distillate (per cent of total distillate to 680° F.)	
To 374° F. min.	35
To 437° F. min.	75
To 500° F. min.	87
To 600° F. min.	97
Residue from distillation to 680° F., Vo. % by difference	30- 45
Tests on residue from distillation:	
Needle penetration at 77° F., 100 g./5 sec.	2- 40
Softening point (ring and, ball), °F.	145-225
Per cent soluble in CCl_4	99.0

Asphalt Coating

The asphalt coating is composed of petroleum asphalt combined with inert mineral fillers. It does not foam when heated to 400° F. It meets the following other requirements:

			Test method
1.	Specific gravity	1.20 max.	ASTM D71-52
2.	Weight, lb./U. S. gal. at 60° F.	10.00 max.	.....
3.	Flash point (COC)	525° F	ASTM D92-57
4.	Softening point (R and B)	200-245° F.	ASTM D36-26
5.	Needle penetration at 77° F., 100 g./5 sec.	6-14	ASTM D5 -52
6.	Noodle penetration at 32° F., 200 g./60 sec.	3 min.	ASTM D5 -52
7.	Needle penetration at 115° F., 50 g./5 sec.	18 max.	ASTM D5 -52
8.	Needle penetration at 150° F., 50, g./5 sec.	76 max.	ASTM D5 -52
9.	Mineral filler, wt. %	10-25	.....
10.	Settlement ratio	1.02 max.	AASHO T109-42
11.	High-temperature sag test at 120° F., 24 hours	None	.....
12.	Low-temperature crack test at 20° F.	None	.....
13.	Peel test, 60° F. to 160° F.	None	.....
14.	Impact test:		
	Direct (area disbonded)	6.05 sq. in.	.....
	Indirect (area disbonded)	None	.....
15.	Water absorption, 35 weeks, wt. %	1.0 max.	.....
	Flow resistance:		
16.	Blunt rod penetration at 85° F., 100 hrs.	10 mils max.	Asphalt Inst.
17.	Blunt rod penetration at 115° F., 6 hrs.	20 mils. max.	Asphalt Inst.
18.	Break test at 77°, 1 in. mandrill	None	.....
19.	Electrical resistance, salt water immersion, 7 days—megohms/sq. ft.	1,000 plus	Asphalt Inst.
20.	Resistivity, ohm-cm.	1×10^{16} min.	.....
21.	Voltage breakdown, volts per mil.	1,000 min.	.....
22.	Viscosity S.s.F. at 375° F.	1,200 max.	ASTM E102-57
23.	Loss on heating 24 hours at 400° F. %	0.5 max.	ASTM D6-39T
24.	Ash % by weight	10-25	ASTM D271-58

Winter Work in Alberta

Work on right-of-ways and river and creek crossings was done in Alberta in the fall and winter. At nearly all the sections there, right-of-way work started in October and November.

Majestic drilled shot holes through the ice and shot rocky river beds at the North Saskatchewan and Highwood rivers. Pipe was laid through the ice where water was low. At other rivers where the ice was not firm enough to support drilling and other operations, the ice was easily broken to clear for the work.

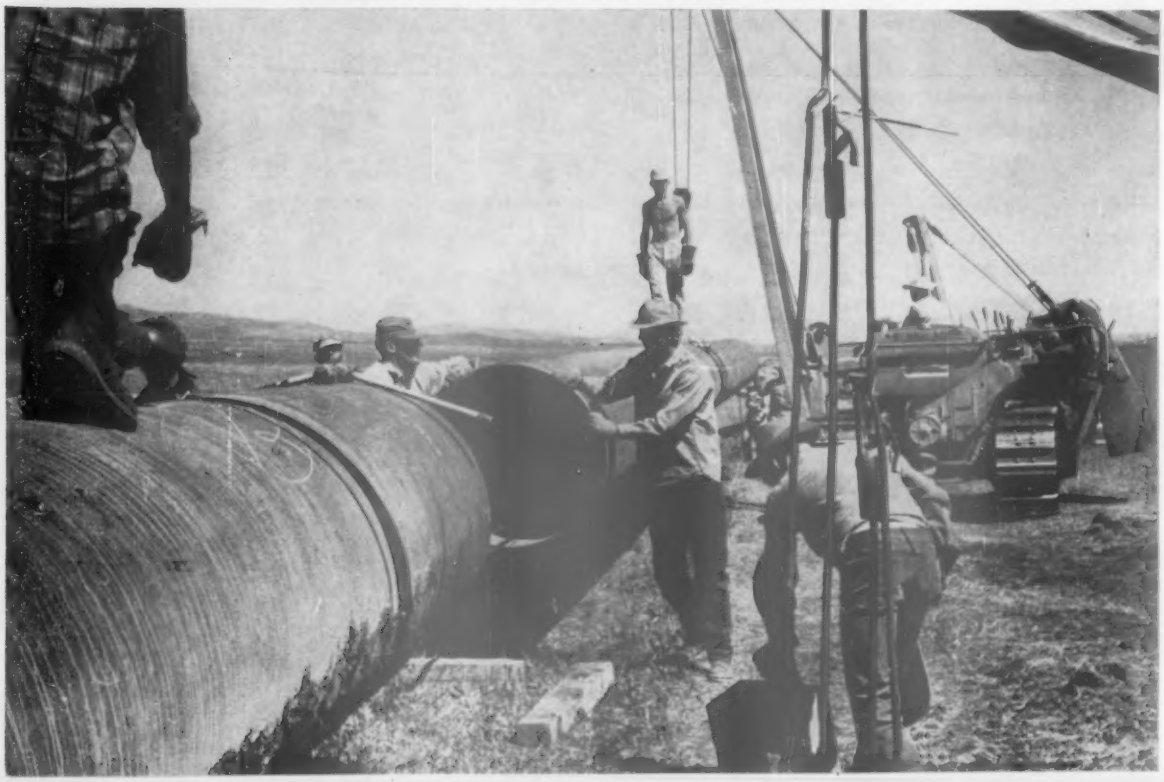
An "ice bridge" was built in the North Saskatchewan River in a way that is familiar in northern regions. Such a bridge is a raised road built up about 2½ ft. by pumping water onto a mat made by saplings where it freezes. The saplings reinforce the bridge. Equipment is moved over it and drills can be operated on it.

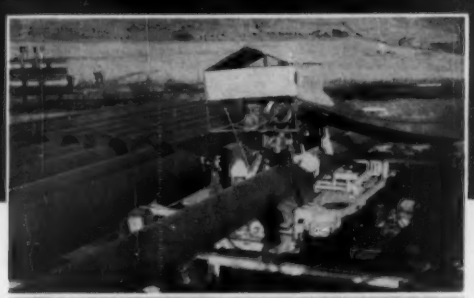
All right-of-way work in Alberta was done in the winter so that the spreads would be ready to go ahead in the spring. As a test run, 6 miles of 36-in. was laid in the province last fall. Lineup and welding work started at the Alberta main line spreads between April 12 and May 30.

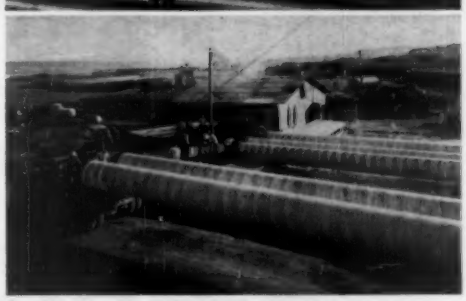
As soon as practicable after completion of backfilling, a proof test of the pipeline is made with pressure up to 1,265 psi. maximum or up to 100% of specified yield of pipe. at sections outside Alberta. Mannix Co., Ltd., is testing for Alberta Natural Gas Co. in British Columbia.

At the Alberta section, to conform with requirements of Alberta Gas Trunk Line Co., Ltd., the line is stressed to a minimum of 82% and maximum of 15% of the yield

SETTING IN AN 80-FT. 30-IN. JOINT at the Majestic pipe gang took only 30 seconds.







throughout . . .

the entire 468 miles of 36 inch pipe . . . lined up, welded, internally cleaned and coated; externally grit blasted, primed, coated and wrapped by Stanley-Bledsoe for Pacific Gas Transmission Company—*every* operation was ◆Quality Controlled.

No "or equal" in your specifications can quite come up to ◆Quality Control. So, specify it. Stick with it. You'll never be sorry. For, in materials, workmanship, latest techniques and equipment . . . Stanley-Bledsoe comes up with performance records on every job.

Before letting *your* next pipeline job . . . ask questions, compare, choose slowly, carefully and wisely, for your own complete satisfaction. That's the best way to see the superiority of ◆Quality Control for yourself.

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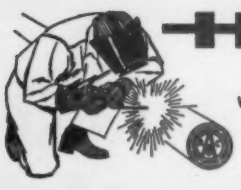
One of the Hardest Jobs on the "HARD YARD*!!" Is Being HANDLED BY HOOD

The final link of the 1,017-mile *Alberta California Pipeline is being constructed by Hood Corporation, California based pipeline contractors. This is one of the hardest jobs of the entire project, which has been so difficult that it is called the "Hard Yard."

Hood's work consists of completing the southernmost section, under contract to Pacific Gas and Electric Company, and includes:

Two 26" pipelines across the Sacramento River—the peat bogs of Sherman Island—the San Joaquin River—and a 36" line to Antioch Terminal—a total of 26,500 feet, dual lines almost all the way.

Hood is proud to have a part in the completion of this important job and offers congratulations to the management and engineers of the firms who conceived and developed the project . . . Pacific Gas and Electric Company, Pacific Gas Transmission Corporation, Bechtel Corporation and all the Canadian firms.



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strength of the pipe. Hydrostatic test pressure varies with the size and wall thickness of the pipe.

The only compressor station built in Canada on the Alberta-California System is in British Columbia just west of Crowsnest Pass. It will have four 3,500-hp. gas-driven reciprocating compressor units.

Construction Firms

The Alberta section of the project is managed and constructed and is to be operated by Alberta Gas Trunk Line Co., Ltd. Engineering is handled in collaboration with and under the direction of Canadian Bechtel, Ltd. The 532 miles of main line and laterals in Alberta have been contracted by Dutton-Williams Brothers, Ltd., Majestic Contractors, Ltd., and Alberta Consolidated Pipe Line Builders (a joint venture of Mannix Co., Ltd., Piggott Construction Co., Banister Construction Co., Ltd., and Marine Pipeline and Dredging, Ltd.).

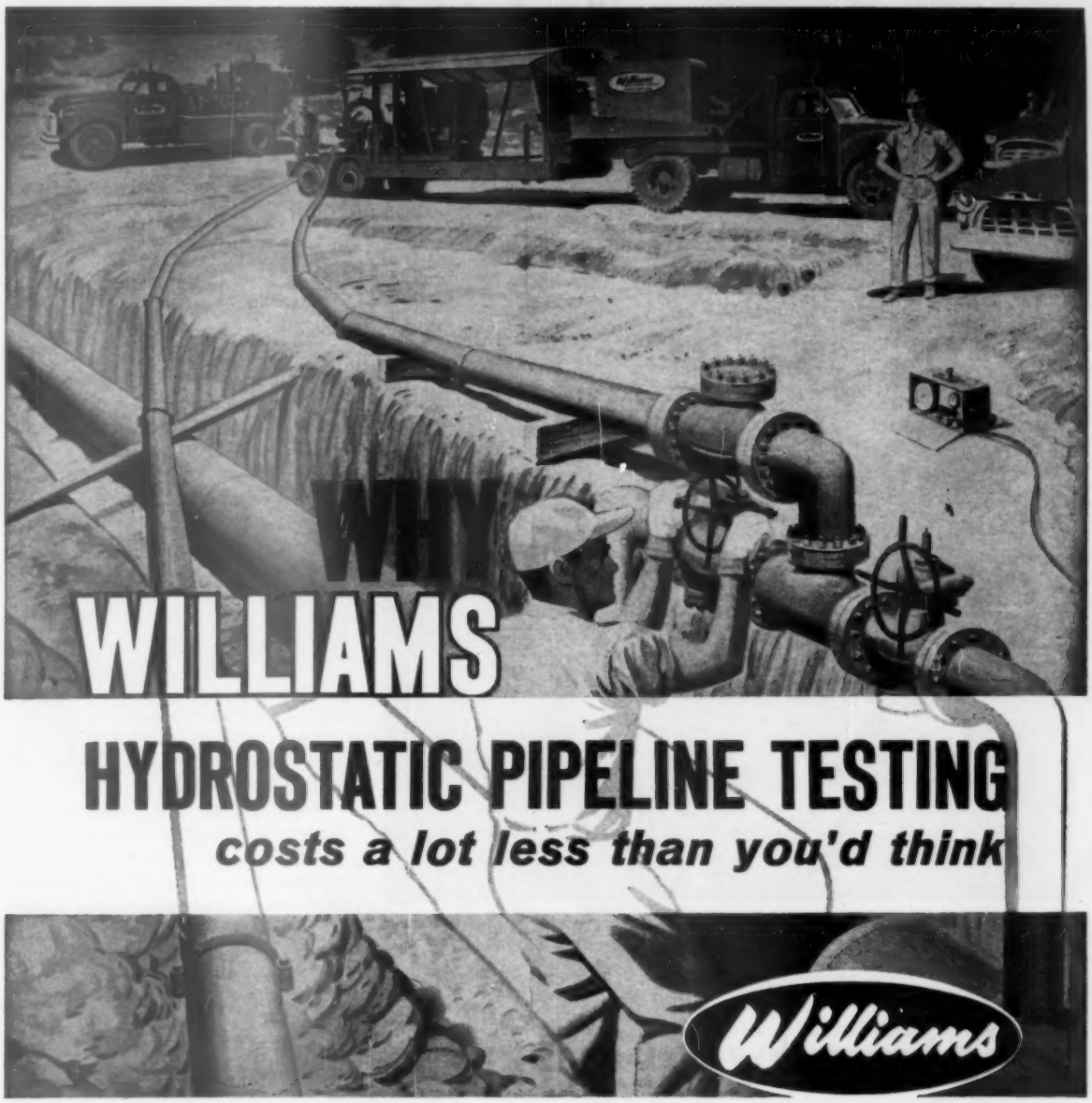
The British Columbia section is to be owned and operated by Alberta Natural Gas Co. Engineering and construction are supervised by Canadian Bechtel, Ltd. The 107 miles of main line in the province have been contracted by Price-Poole of Canada, Ltd. (a joint venture of H. C. Price Co. of Canada, Ltd., and Poole Construction Co., Ltd.), and by Mannix Co., Ltd. The compressor-station construction has been contracted by Marwell Construction Co.

Contractors for the sections of the project in the United States include H. C. Price Co., J. P. Neill & Co., Inc., and Western Pipeline, Inc. (as a joint venture) and Stanley-Bledsoe Corp. (double-jointing and treating-plant operations).

Bechtel Corp. has engineering, management, and supervision for the construction work in Idaho, Washington, and Oregon for the 614-mile section to be owned and operated by Pacific Gas Transmission Co. The 296-mile California section is owned, constructed, and engineered by Pacific Gas and Electric Co.

Acknowledgment

In the preparation of this article assistance was given by H. F. Waste, Bechtel Corp.; R. J. Ross, M. P. Boyle, C. E. Barker, T. J. Barber, T. B. Johnson and D. F. MacDonnell, Canadian Bechtel, Ltd.; H. C. Price, Jr., H. C. Price Co.; E. M. Hubach, Williams Brothers Co., and R. L. Leonard, Majestic Contractors, Ltd.



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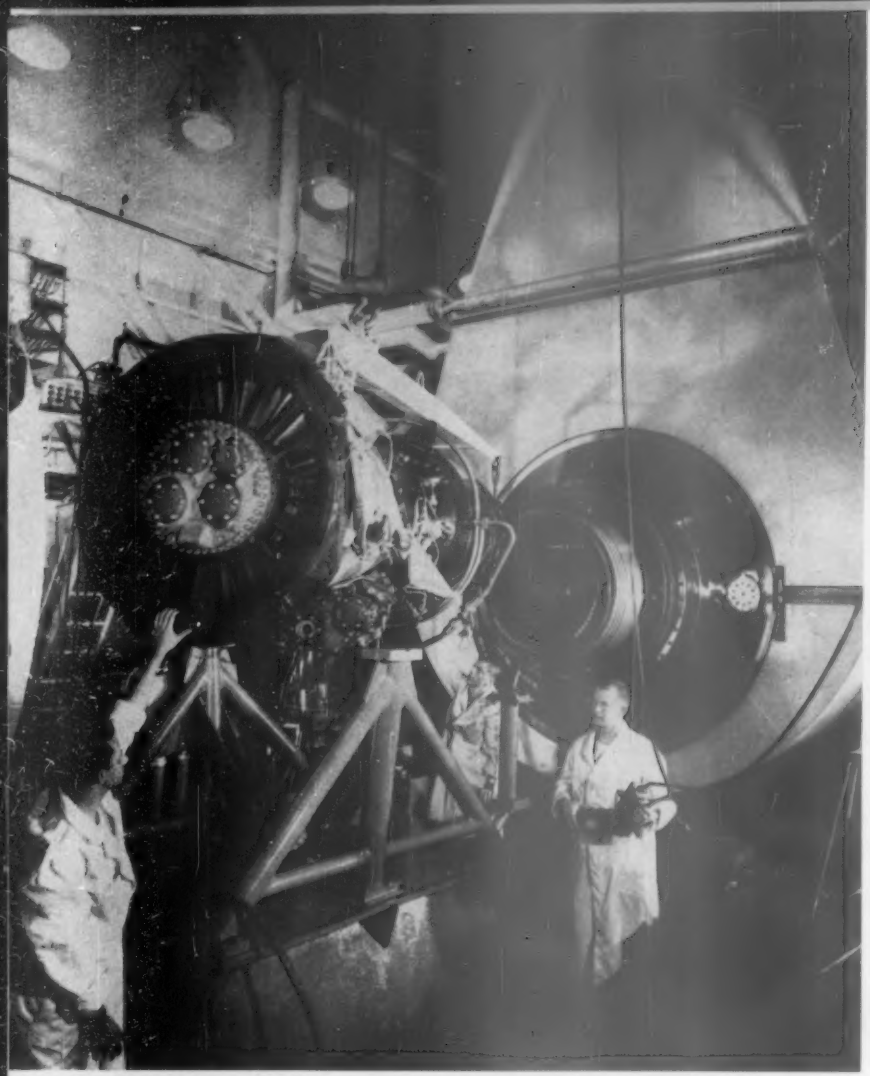


JET ENGINE at left was tested for over 300 hours at Pratt & Whitney Aircraft laboratory befort it was delivered to Clementsville, Ky. Here it was joined with a power turbine for the first time.

Aviation-type turbine delivers for Columbia

with results that portend a new concept compressor-station design,—that of being "just a pump in the pipeline." Prospects:

- A single building—a simple covering for equipment
- Compressor unit installed directly into piping line
- A site of 4-5 acres instead of 20-40
- Unattended, remotely controlled station

BY SY ORLOFSKY
Vice President, Columbia Gulf Transmission Co.

THE Columbia Gas System has operated a 10,500-hp. jet gas turbine, driving a two-stage centrifugal compressor at its Clementsville, Ky., station since October 31, 1960. Projected yearly operating costs are $21.70 per installed horsepower, comparable to four-cycle engine-driven centrifugal stations.

Other results from the first 10 months of operation are:

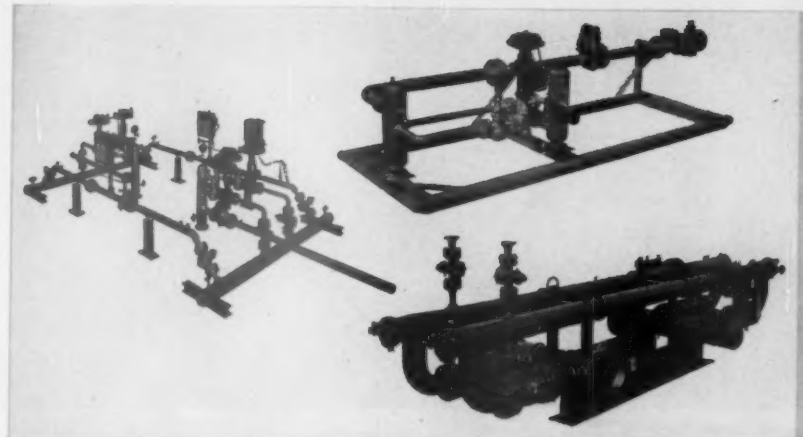
- Thermal efficiency without regeneration is about 25%.
- Fuel consumption at rated load is 10.4 cu. ft. per b.hp.-hr.
- Station noise level is no problem if design is adequate.
- Overhauling takes only 10 to 12 hours, about the time required for a routine inspection of other prime movers. Annual overhaul cost should not exceed $1.25 per installed horsepower.

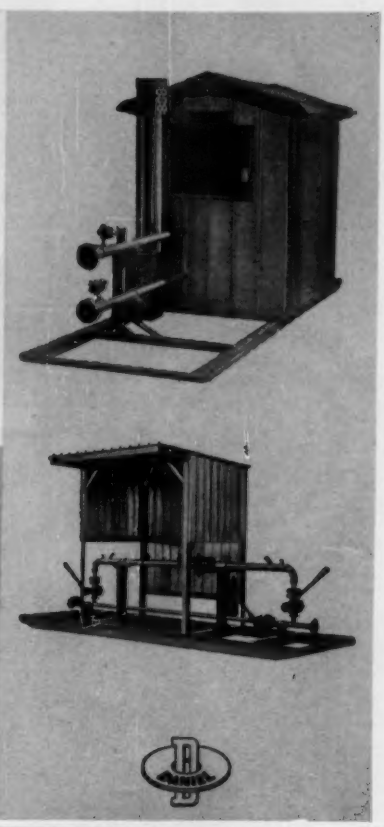
New system. The Columbia Gas System is primarily concerned with stabilizing prices in every area of its operations. Columbia's partnership with Cooper-Bessemer Corp. and Pratt & Whitney Aircraft in the jet gas-turbine experiment is to demonstrate and prove a new compressor-station design concept—low initial cost and high dependability of operations by using aircraft-type large-size power packages designed to operate unattended and remotely controlled.

Cooper-Bessemer brings into the experiment engineering, development and manufacturing abilities that have served the natural-gas-transmission industry since its beginning.

A major factor contributing to the success of the experimental program is Pratt & Whitney Aircraft's experience, engineering talent, and vast testing and mass-production resources in the design of aircraft jet engines.

The installation. The Clementsville, Ky., installation consists of a 10,500-hp. Cooper-Bessemer RT-248 jet gas-turbine driving a Cooper-Bessemer RF2B-30 two-





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Start measuring gas immediately at the wellhead or at city gate sites with Daniel packaged, orifice meter stations. You save time in delivery, and save money in field labor costs with a complete Daniel package ready for tie-in to your line. Here are just a few examples of portable, skid-mounted units built by Daniel to customers' specifications. Each unit can be tested and X-rayed at the modern Daniel plant before shipping, and fitted with the meters of your choice. Want more facts? Write for Bulletin MS-1.

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  Mfd. by Irish Pipe Line Supply Co.
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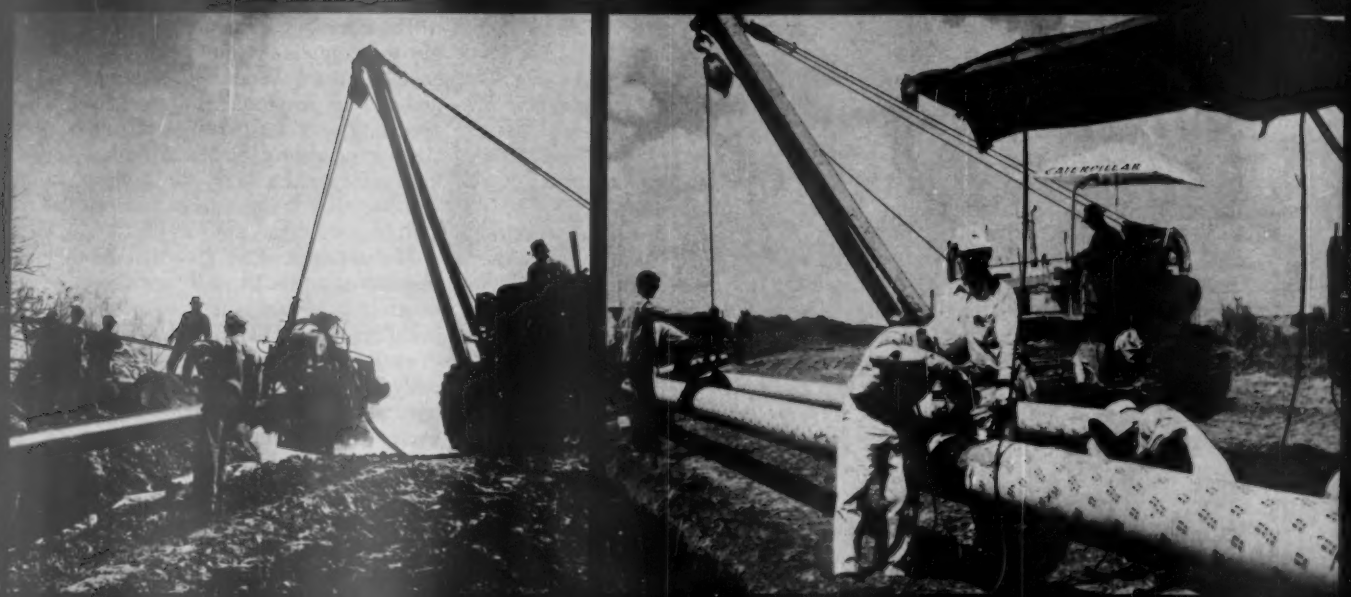

off on the right-of-way

Additional Jones & Laughlin tests and advanced mill practices guard the quality of J&L line pipe. The pipe is easy to bend, line up, and weld.

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Jones & Laughlin Supply Division—Tulsa

stage centrifugal compressor. Clementsville is the site of a 14,000-hp. main-line compressor station. The RT-248 jet gas turbine utilizes a commercial version of the Pratt & Whitney Aircraft J57 jet-aircraft engine as the gas generator.

The gas generator incorporates a low-pressure axial compressor operating at 6,000 r.p.m., a high-pressure axial compressor running at 9,000 r.p.m. diffuser, burner, and a three-stage turbine. The burner or combustion chamber pressure is 148 psia. The inlet temperature to the three-stage turbine is 1,380° F.

A significant modification to the J57 jet engine for stationary application is the fuel system that allows the unit to burn natural gas. The unit's power turbine is a two-stage machine that extracts the power from the exhaust gases of the gas generator and transforms it into shaft horsepower to drive a centrifugal compressor.

The two-stage centrifugal compressor is designed to handle 650 M.M.c.f.d. at a suction pressure of 715 psig. and a discharge pressure of 935 psig. The rated speed of the power turbine is 5,000 r.p.m. as is the compressor. The inlet temperature to the power turbine is 865° F. and outlet temperature of 695° F.

The combination of two components directly driving the two-stage centrifugal compressor produces a highly compact and versatile jet gas turbine for natural-gas transmission. The jet gas turbine requires no regeneration equipment to obtain a thermal efficiency of 25%. Recent field tests have substantiated the 25% thermal efficiency of the machine. Elimination of the regenerator reduces initial cost and simplifies the station design.

The initial test period at Clementsville to determine reliability and operating costs is 8,000 hours of actual operation or an 18-month period, whichever occurs earlier.

First operation. Construction of the station began April 8, 1960, with the jet turbine being placed on the line for the first time on October 31, 1960. As of September 1, 1961, the RT-248 jet gas turbine has been operated over 5,000 hours. During the 5,000-hour period the J57 jet gas-turbine gas generator has performed to expectations.

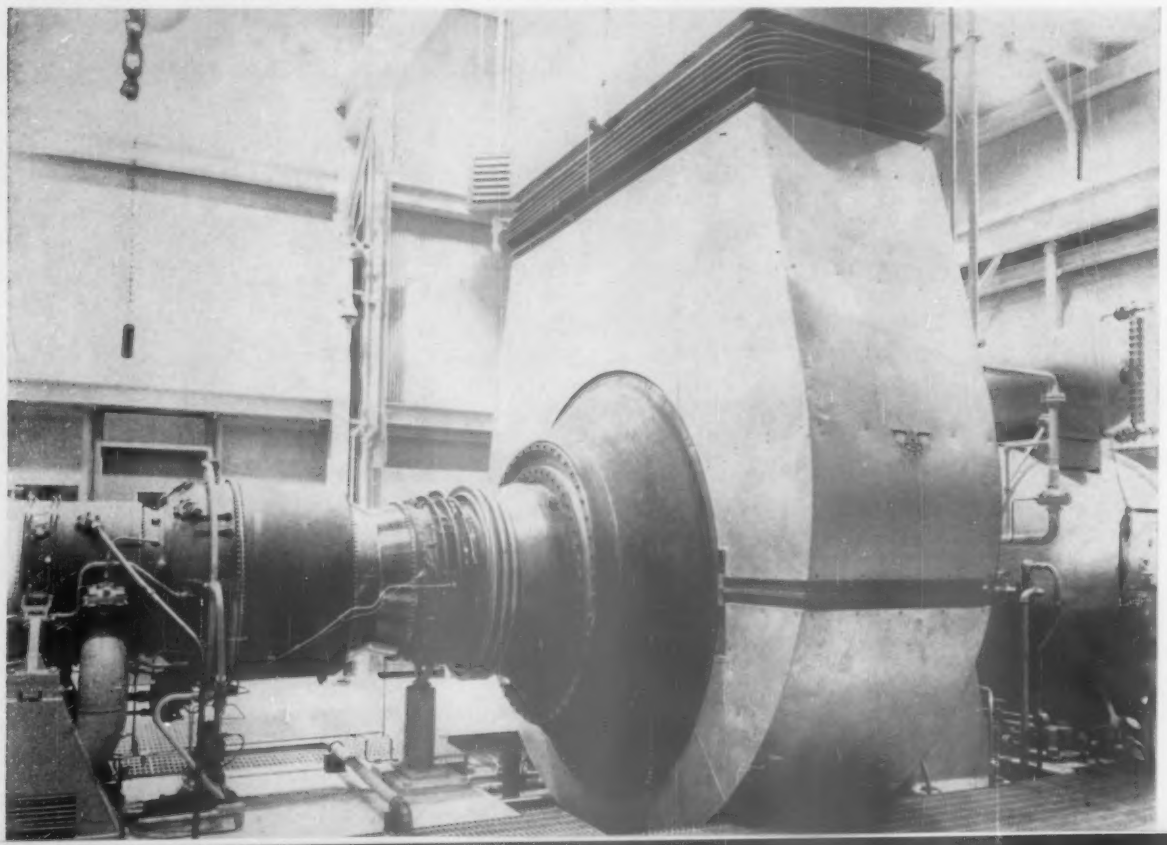
The gas generator has now amassed more than twice the continuous hours of operation without overhaul of any similar aircraft jet engine running today. During this 5,000 hours of operation, the jet gas turbine has developed an average of 10,757 hp., and for 219 hours of the 5,000 hours the machine has delivered 12,000 hp. or over.

Operating costs. These have been encouraging and gratifying. Based on costs to date, projected for a year, the operating cost per installed horsepower is $21.70. The $21.70 consists of labor, $1.65; supplies and expenses, $2.04; fuel, $16.60; supervision, $0.75; and lube oil, $0.66. Fuel costs are calculated at $0.22 per 1,000 std. cu. ft.

The operating costs are comparable to Columbia Gulf's four-cycle engine - driven centrifugal stations and are an improvement over the operating costs for the two-cycle reciprocating engine plants. Although the fuel costs are high, the savings in labor and maintenance and operating costs offset the fuel cost.

Maintenance. One fact that has become apparent through operating experience is that a jet gas-turbine installation may eliminate overhaul or major inspection periods as presently practiced in the industry. Most gas-transmission companies either overhaul main engines annually or on a preventive-maintenance sched-

OVER-ALL VIEW of Clementsville station, showing jet engine, gas turbine, and associated facilities.



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With almost every section of the 36-inch Alberta-California pipeline on —or ahead of—schedule, Canadian natural gas is due to arrive in central California by December. Bechtel is the engineer-manager of three of the four sections of the 1400 mile project.

The rapid completion of one of the world's largest pipelines illustrates the advantages of engineering-management services which reflect Bechtel's resources and specialized experience with similar major pipeline systems.

Working closely with the engineering staffs of Pacific Gas and Electric Company and the other companies which will operate sections of the line —Pacific Gas Transmission Company, Alberta Natural Gas Company and The Alberta Gas Trunk Line Company Limited—Bechtel prepared the economic and engineering studies on which the $300 million system was developed, located the route from California north and is manager of construction from the wellheads near Edmonton to the California-Oregon border.

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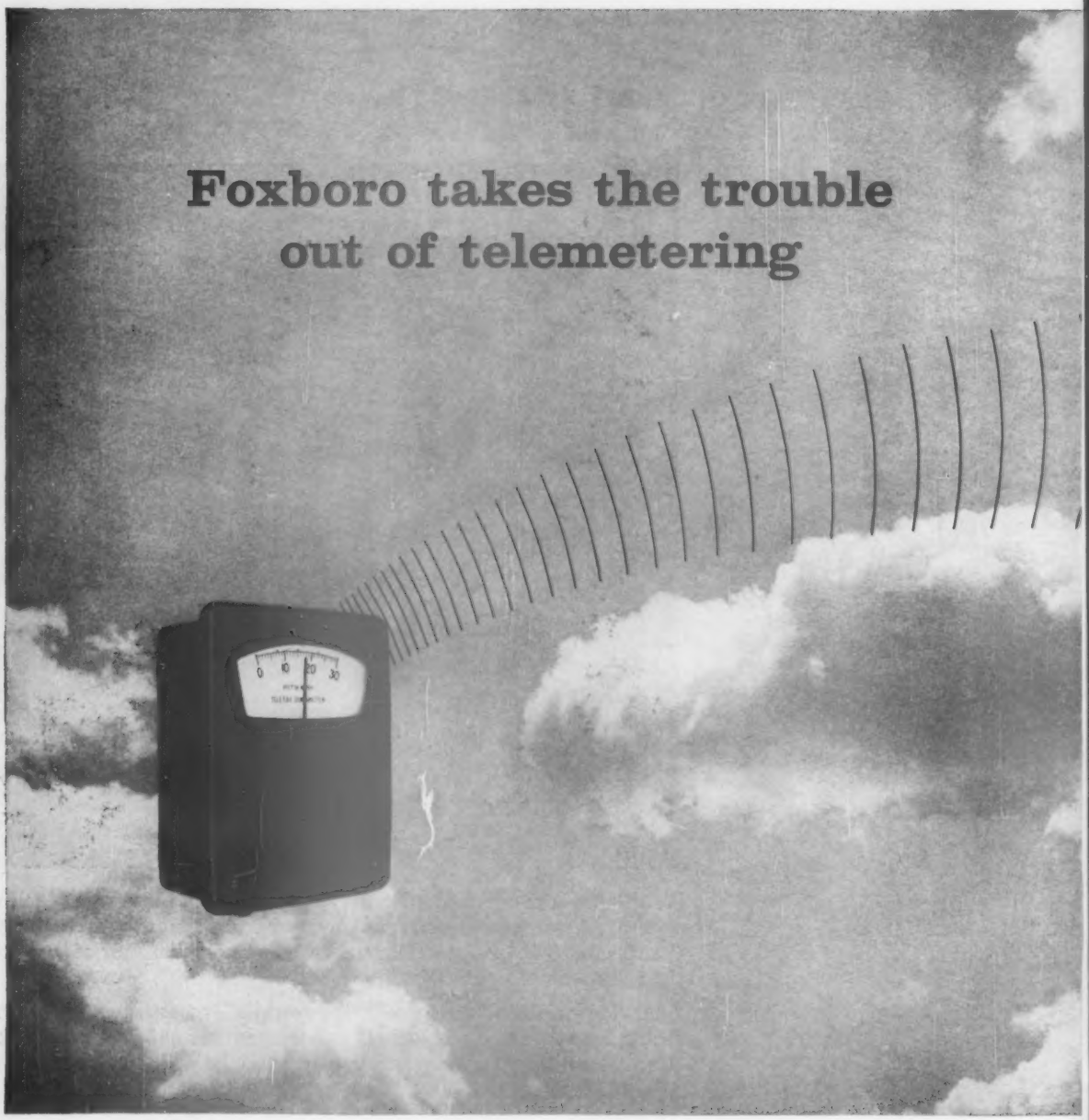

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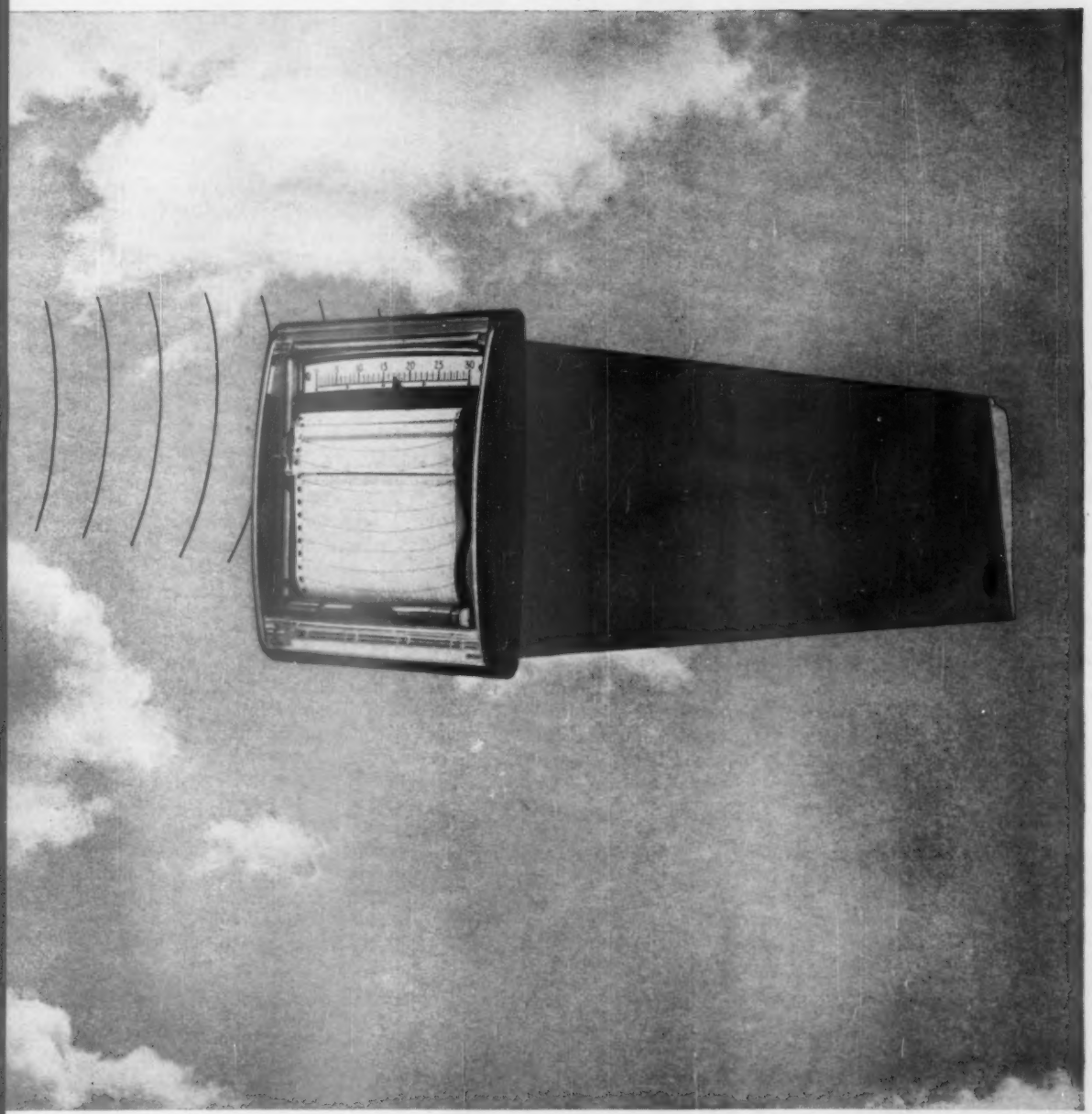

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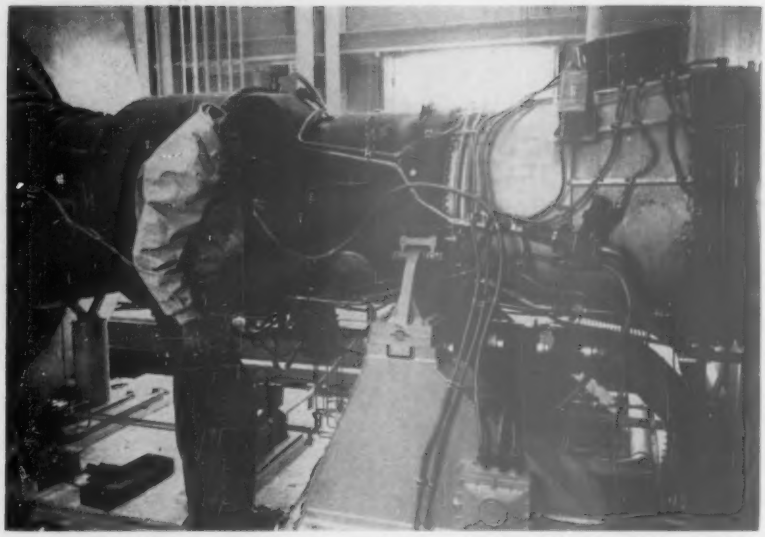


GAS GENERATOR which wighs only 4,000 lb. can be changed out in four hours.

ule that calls for a complete inspection every 1½ to 2 years.

Two-cycle engines in the 2,000-hp. class require 5 days to overhaul, while two-cycle and four-cycle engines in the 3,500 to 4,000-hp. range take as much as 3 to 4 weeks to completely inspect. The cost of overhauling engines varies from $1.75 to $3.00 per installed horsepower depending on the condition of the engine. This cost includes labor and parts.

Overhauling a 10,500-hp. jet gas turbine will be similar to a routine inspection. The time to accomplish the inspection should not take more than 10 to 12 hours. At the completion of 8,000 hours, the gas generator will be replaced with a spare or tradeout unit and returned to the factory or central repair shop for inspection. The inspection and any required repairs will be performed by the manufacturer.

At the time the gas generator is changed out it becomes a simple matter to visually inspect the gas generator and compressor. Present predictions indicate the gas generator should provide 40,000 hours of continuous service without requiring a complete teardown and possible parts replacement. The cost of the annual jet gas-turbine inspection is predicted to not exceed $1.25 per installed horsepower.

Another contributing factor toward reducing costs is that a jet gas—turbine station does not require the large stock of engine parts and tools needed in the normal operation of conventional stations.

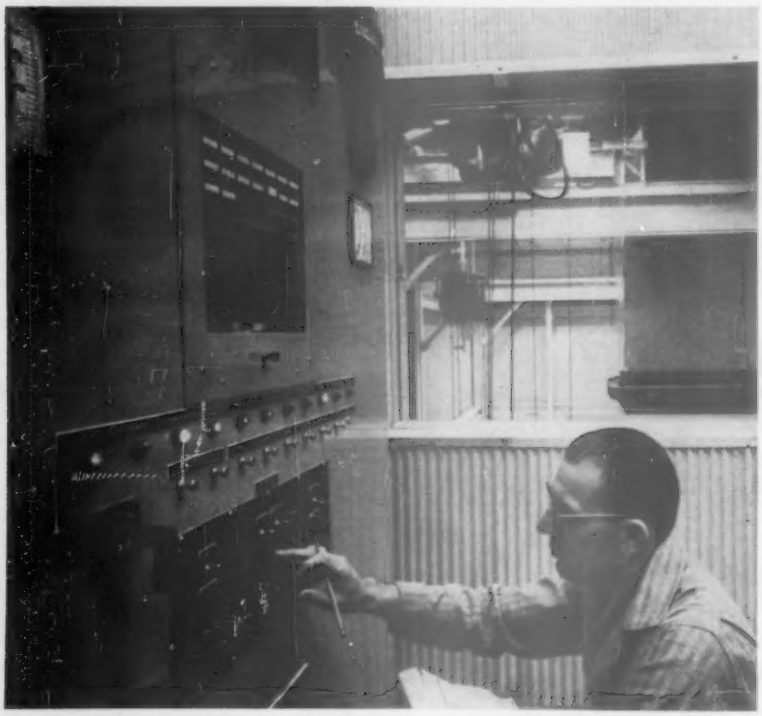
The jet gas-turbine station was installed at Clementsville for $157 per horsepower. This experimental station was constructed on an existing plant location. A similar installation constructed at a new site is estimated to cost $190 per horsepower or possibly less. The Clementsville project has proven that a jet gas-turbine plant can be constructed for approximately 50% of the cost of a conventional reciprocating-engine station for gas-pipeline service.

Construction features. A few of the construction features of the jet turbine station when compared to conventional stations are:

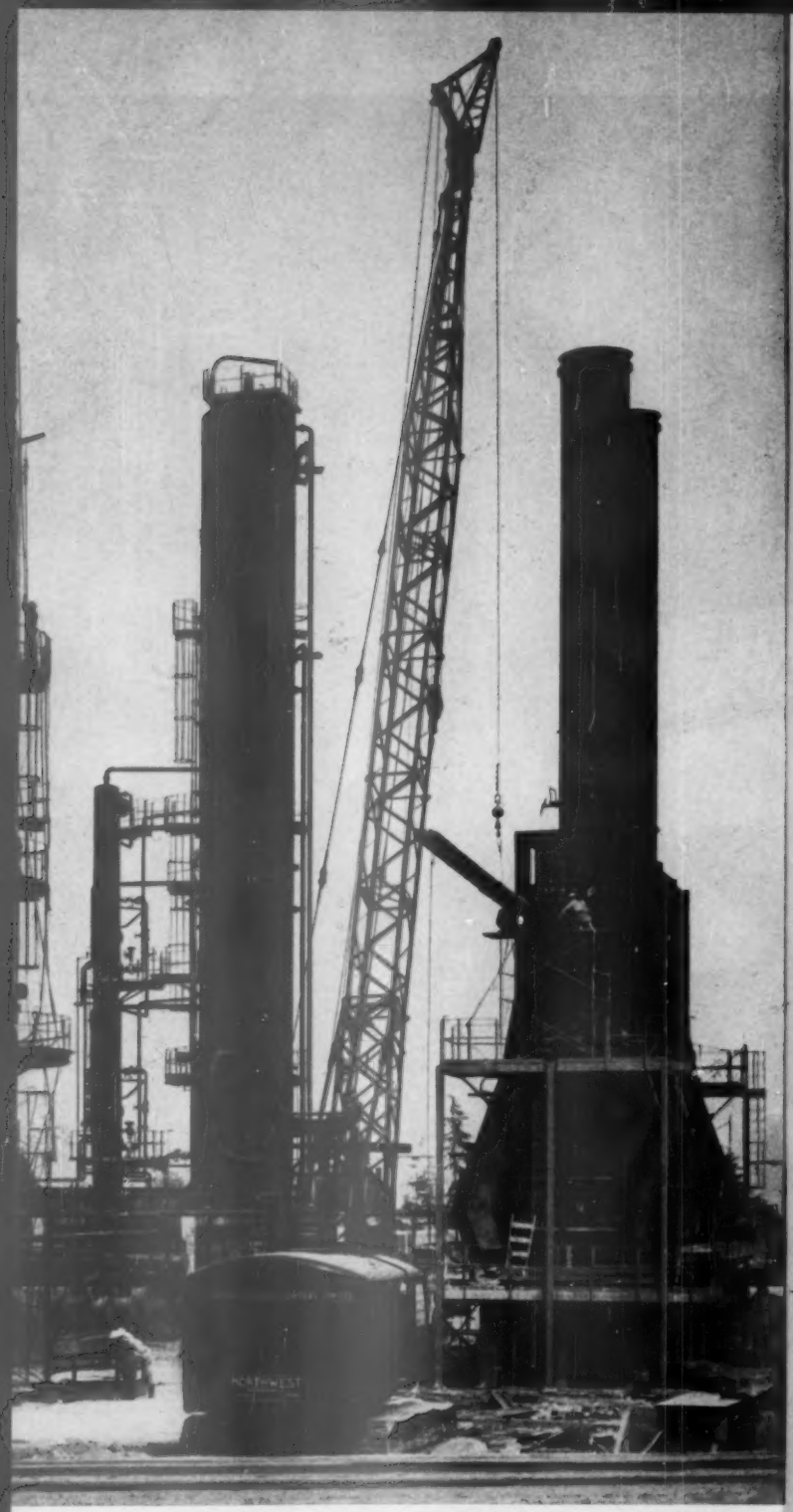
1. The jet gas turbine weighs 17 tons or 3.2 lb. per installed horsepower, while conventional gas-reciprocating engines totaling 10,500 hp. weigh 356 tons or 65 lb. per installed horsepower.

2. The turbine foundation and floor-space requirements are greatly under those of comparable reciprocating-engine and traditional gas-turbine plants. The jet turbine requires 52 lb. of concrete per installed horsepower and 0.12 sq. ft. of floor space per installed horsepower, against reciprocating-engine foundation needs of 402 lb. per installed horsepower and 0.40 sq. ft. of floor space. The conventional gas-turbine foundation requirements are 177 lb. of concrete per installed horsepower and 0.18 sq. ft. of operating floor.

Preliminary tests. Pratt & Whitney Aircraft conducted extensive experiments on the gas generator, amassing over 300 hours of test op-



CONTROL ROOM inside jet-gas turbine station. Observer is taking operations data from main control panel.



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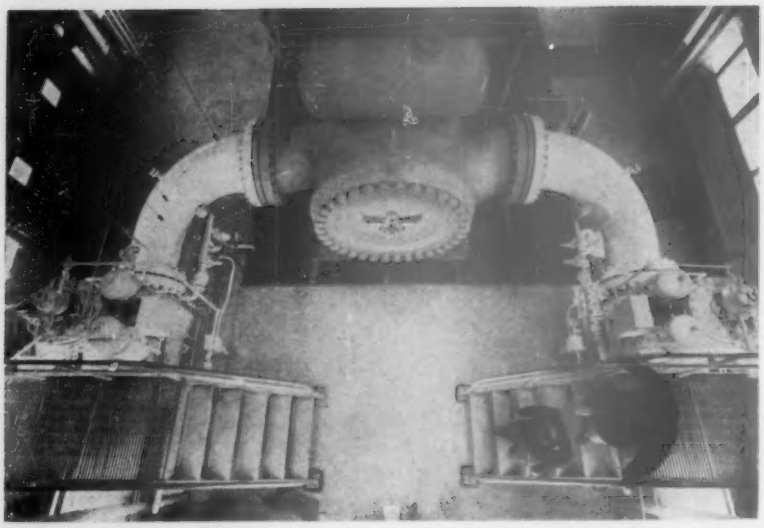

CENTRIFUGAL COMPRESSOR at Cementsville delivers 10,500 hp. and moves about 600 M.M.c.f. of natural gas per day.

erations. As soon as the Cooper-Bessemer power turbine arrived in East Hartford, the two machines were combined in a test cell in Pratt & Whitney Aircraft's Willgoos laboratory. The machine running as a unit was subjected to strain-gage investigations of the disks and blades under a complete range of loads and speeds.

These tests lasted 3 months and included complete temperature studies of the power turbine, disks, and stators, involving time-temperature studies on loading and unloading. Turbine performance was determined at variable speeds up to rated speed, and severe torque tests were made at low speeds.

All the test results were satisfactory and only pointed up the requirements for using the standard eight-strut arrangement for the J-57 jet engine instead of four. The struts act as flow straighteners and are located in the exhaust section of the gas generator. The four struts were an experimental configuration.

Problems. In any adventure to expand knowledge and advance technology there are always accompanying problems. The Clementsville experiment has been no different in this respect. A vibratory structural failure of the connecting duct between the gas generator and the power turbine caused some concern. However, the difficulty has since been corrected and all of the developmental and mechanical problems for the Clementsville installation are felt to be past. It is now just a matter of continuous operation of the machine to reach the 8,000-hour goal, which should be reached by late December 1961.

Noise level. Jet compressor-station noise level is no problem when adequate consideration is given to noise attenuation in the initial plant design. At Clementsville the noise level in a radius of 50 ft. from the center of the exhaust stack is from about 85 db., and at 200 ft. the noise level is about 76 lb. In comparison, the noise level 50 ft. from the building is the same as produced by heavy office machinery. At 200 ft. it is completely within the unobjectionable noise level. The noise level in the engine room space is high and varies from 104 to 107 db. This is of no concern for there is no need for personnel to be in the engine room while the jet turbine is running. The noise level in the control room falls well within the unobjectionable noise range.

Still to be proven is the question of the jet turbine operating with an acceptable availability during an 8,000-hour period. A spare gas generator is retained at the station and, if necessary, this unit can be installed in 4 to 6 hours.

The station has been operated remotely from the Columbia Gulf gas control center at Nashville, Tenn., since June 20, 1961.

Because of its simplicity, ease to completely automate, and low weight per horsepower ratio, the jet gas turbine opens up a new realm for advanced compressor-station design. Jet gas-turbine compressor-station technology that is now available can very well make obsolete present compressor-station design criteria.

Lowering costs. To the gas-transmission companies concerned with lowering compressor-station investment costs, the jet gas turbine can lead to the concept of the compressor station being reduced to "just a pump in the pipeline." The designers and constructors of future main-line compressor stations by using the jet gas-turbine principle can produce low-cost installations that would contain the following beneficial features:

1. Only 4 to 5 acres of land would be required for a compressor-station site instead of the conventional 20 to 40 acres or larger tract.

2. A compressor unit would be installed directly into the piping line, eliminating the complex and expensive yard gas piping inevitably used in present designs.

3. The station will need only a single building, which could take the form of a simple covering for the equipment.

4. The station will be completely unattended and remotely controlled. No employe would be in attendance at any time during the normal operations of a station. The preventive maintenance and major inspection would be conducted by a roving repair crew that would visit the station periodically. Possibly the crew could move from one location to another by helicopter. The highly mobile crew would carry with it all of the tools and equipment required to perform routine preventive maintenance.

5. Foundation requisites would be kept to a minimum with the jet turbine being skid mounted and being delivered to the station site fully equipped and ready to operate.

Perhaps the most important consequence of the jet gas-turbine experiment is that it demonstrates that industry must accept innovation and the responsibility for its risks and results. One can no longer ask whether there should be change, or even how fast. The gas industry must embrace innovation in order to stabilize costs and to remain competitive.

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Snakes, mosquitoes, heat, rain, mud -- pipeliners crossing Louisiana's Bonnet Carre Floodway, Bayou Des Allemands or Tensas Parish swamplands can do little about such nuisances. But they can do something about better, faster, more economical pipeline construction.....by using STUPP CORPORATION high-yield strength, lightwall steel line pipe.

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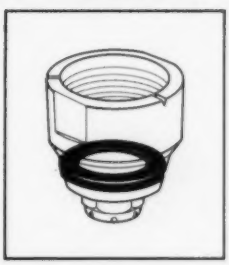

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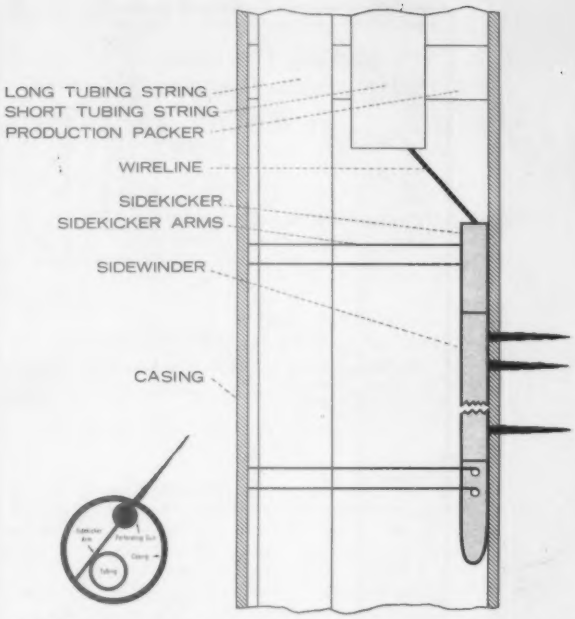
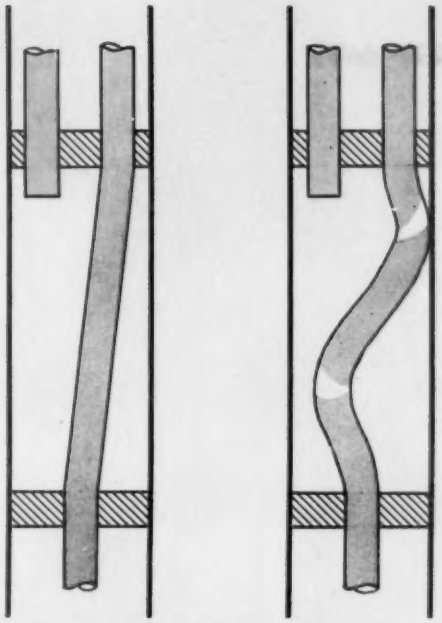


SIDEKICKER orients the perforating tool in a dual completion so that the long tubing string will not be damaged when perforating the upper zone of a dual completion. At the same time the tool is forced against the casing, eliminating "standoff."



UPPER-ZONE PACKER set with the short tubing string in a dual completion leaves the long string in tension as shown at left. If the upper-zone packer is set with the long string, compression results in corkscrewing as at right. This can mean trouble if wire-line tools are run into the hole through the short tubing because the cable can get twisted around the corkscrewed tubing, sticking the tool.

To prevent trouble in dual completions . . . set the upper-zone packer with the short string, and keep the long string in tension

BY WELDON PORTER
Welex, Inc.

UPPER-ZONE PERFORATIONS in a dual completion are not hard to get anymore. But there is a chance of real trouble if foresight is not used when completing.

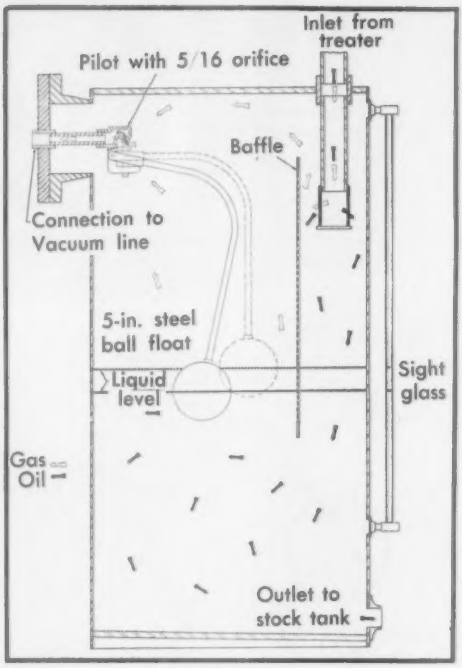
Mechanical orientation of the perforating tool with the Welex "Sidekicker" (OGJ, Sept. 12, 1960, p. 97) prevents the perforating gun from shooting holes in the long tubing string. The tool is lowered through the tubing, with a spring-loaded arm folded against the body of the tool. When the tool falls into the casing below the tubing, the arm unfolds and forces the tool against the casing, so there is no "standoff." This action also insures that the explosives will not penetrate the long tubing string at this point. The sidekicker arm is on the opposite side of the tool.

Here's trouble. On two recent jobs, the gun has become stuck in the hole. Reason was not known at first. But on the second well, with the derrick still on the location, the long tubing string was picked up, and the gun was immediately freed.

Here's the cure. In both of these cases, the packer in the hole was a long-string-set packer. The order of events in completing a well with a packer of this type, is such that the long string of tubing ends up in compression, resulting in corkscrewing of the long string below the upper packer. The perforating tool cable had been caught around the long string with a "cat head" wrap in the cable.

This trouble can be avoided by using a short-string-set packer. The short-string-set packer is run on the long tubing string. The long string can be latched into the packer or left floating through a seal sleeve. When the short string of tubing is run into the well, it is fitted into the upper dual packer and causes the packer to be set. The long string acts only as a carrier for the packer, and permits it to be positioned in place. But the short string does the setting. This leaves the long string of tubing in tension, and the tendency for corkscrewing is eliminated.

Use short gun. As an extra precaution in perforating the upper zone, it is recommended that the perforating tool be no longer than 10 ft. Tools as long as 30 ft. have been used successfully, but experience has shown that the 10-ft. tools are safer.



SMALL, INEXPENSIVE VESSEL, mounted on top of a stock tank, dumps stabilized crude to the tank. Vacuum line takes gas from the top of the vessel whenever the pilot valve is opened. Typical field installation is at left, and construction details are shown in the schematic drawing.

WHERE LACT IS USED, the same type of separating vessel can be mounted on the surge tank ahead of the metering equipment.

Small leases can profit from crude stabilization

The investment is small, the payout fast

BY WILLIAM B. DAVIS AND
LEON B. DORSEY
Sinclair Oil & Gas Co., Tulsa

STABILIZATION can be used to accomplish these things:

- Reduce loss of stock-tank vapors.
- Reduce shrinkage factor.
- Deliver more stable crude to pipeline.
- Separate and recover more condensate.

Stabilization has also increased the amount of liquid in each 1,000 cu. ft. of lease gas.

The possibility of gas "breakout" in the positive-displacement meters of automatic-custody-transfer units is also lessened by a more stable crude. Stock-tank weathering time is reduced, resulting in less stock-tank capacity needed on the lease to provide the necessary storage time.

This article will be limited to a discussion of the reduction of stock-tank gas losses. Stock-tank gas is normally vented to the atmosphere.

Stabilization on the lease may be accomplished by:

1. Stock-tank weathering, which is inefficient and uneconomical.
2. The use of tall stabilizing tow-

Presented at the spring meeting of Mid-Continent District API, Tulsa, April 1961.

Dayco CORPORATION

Dayton Industrial Products Co. Div. Melrose Park, Illinois

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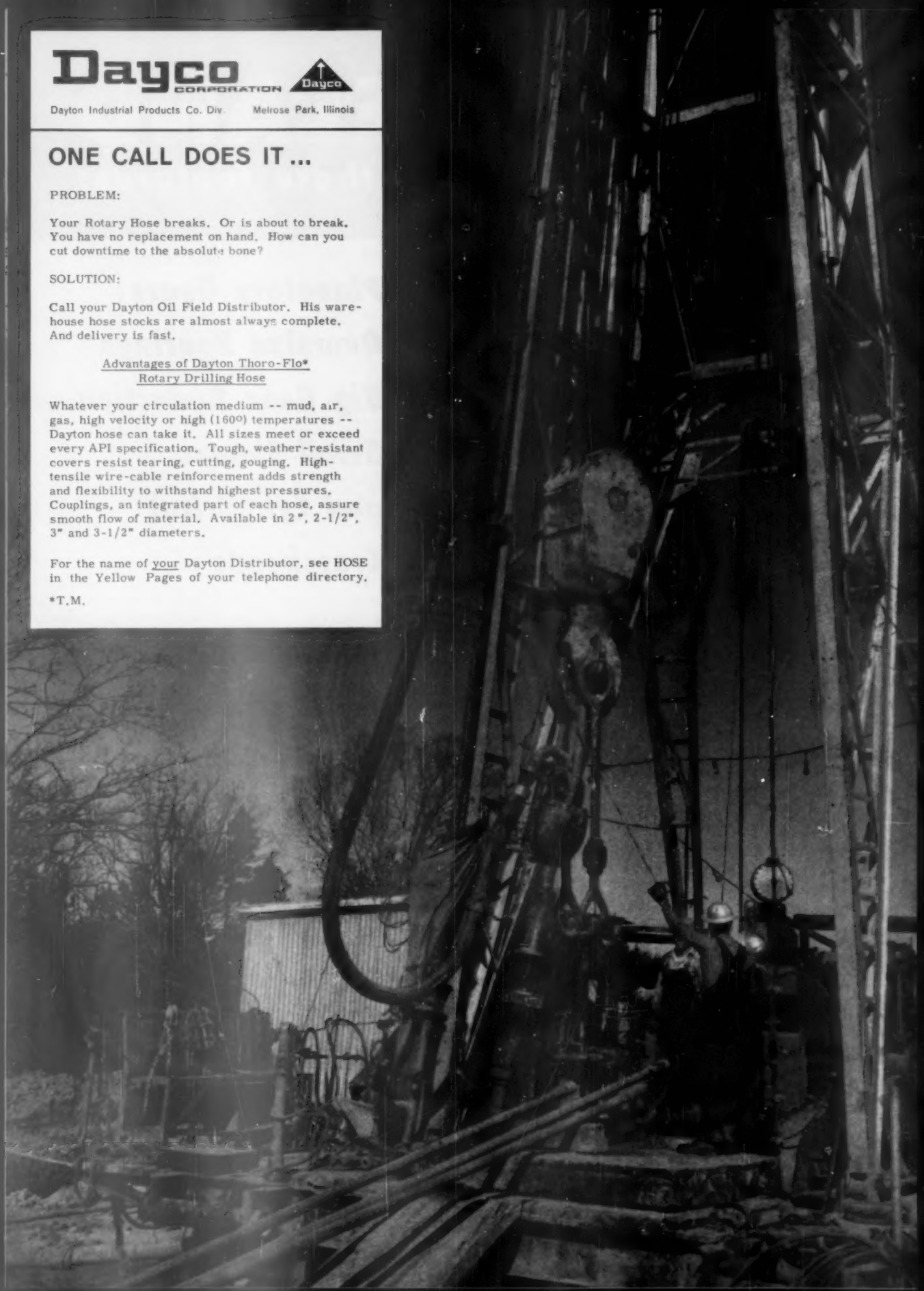

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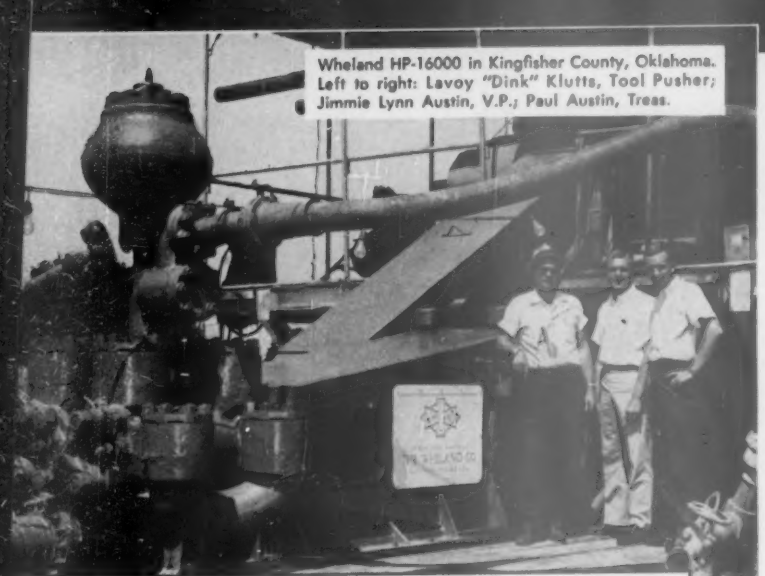

Wheland HP-16000 in Kingfisher County, Oklahoma. Left to right: Lavoy "Dink" Klutts, Tool Pusher; Jimmie Lynn Austin, V.P.; Paul Austin, Treas.

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Seminole, Oklahoma

August 1, 1961

Mr. Gordon P. Street, President
The Wheland Products
Division of Gordon Street, Inc.
Chattanooga, Tennessee

Dear Mr. Street:

As you know, we have used Wheland pumps for many years. From our own experience we became convinced that the Wheland HP-14000 Pump couldn't be beat.

But your planetary HP-16000 Pump is so quiet and smooth running that we are digging more hole faster and at less cost. Part of the increased penetration comes from the fact that the HP-16000 is bigger than the HP-14000. But that is only part of the story.

The new planetary gears let us use a much smaller sheave. The cylindrical crossheads, oversize bearings and the big gear reduction make the pump easier to pull, run smoother, and do a better job.

We have used this pump in Kingfisher County, Oklahoma, and find it just right for this area.

Yours very truly,

JIMMIE AUSTIN & SONS, INC.

By Jimmie Austin
President

JA:rmm

WHELAND PLANETARY

HP-16000

Duplex Power Slush Pump
7¾" x 16", 600 H.P. at 65 RPM

WHELAND

ROTARY DRILLING MACHINERY

THE WHELAND PRODUCTS
DIVISION OF GORDON STREET, INC.
CHATTANOOGA, TENNESSEE, U.S.A.

DRAWWORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC. —Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC. — Main Office: Houston, Texas.

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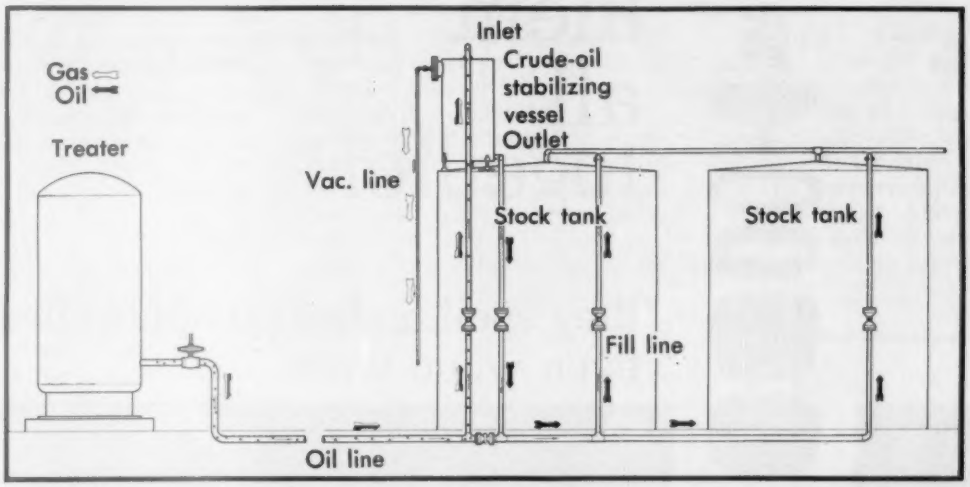
System must be low in first cost and maintenance.



OVER-ALL PIPING DIAGRAM for a typical field inatallation, showing relationship between treater, separating vessel, and stock tanks. Mounting the vessel on top of a stock tank is the most economical way to get the needed elevation.

ers, which are expensive and not suited for small volumes of gases and condensate.

3. Stage separation, which is the method described here.

Gas liberated at the stock tanks represents a significant part of the flowing fluid. This volume of gas, liberated from the normal range of crude oils by reducing the pressure from 20-psi. separator or treater pressure to atmospheric pressure, has been found by well-fluid analysis to be greater than that liberated in any other 20-psi. increment or pressure reduction from reservoir pressure to atmospheric pressure. On an average, it can be anticipated that approximately 3% of the liquids dumped from separators or treaters will not be retained in atmospheric stock tanks.

Any system for the reduction of losses or recovery of stock-tank gases on small leases must of necessity be low in first cost and maintenance, because of the limited volume of gas recovered.

Recovery of gas directly out of the stock tanks requires expensive and delicate devices to prevent damage to the tanks. Also, the stock tanks must be made "vaportight." This method is suitable only for large consolidated tank batteries where the recovery of large amounts of gas will justify the expense.

New slant. The problem was approached with the idea of withdrawing the volatile gases from the crude oil before it enters the stock tanks. A small, relatively inexpensive separator vessel was developed for this purpose. The separated gas can be withdrawn from the vessel into a vacuum gathering line or a low-pressure gathering line.

Vessel is 24 in. in diameter and 4 ft. in height. It has a 3/16-in. shell thickness and ½-in. head thickness and is welded. Flat heads, rather than bumped heads, were used to effect a saving in cost. The vessel will withstand an internal vacuum of 26 in. of mercury before collapse. Three adjustable legs make the vessel easily leveled and plumbed. The sight glass on the side shows the liquid level in the vessel.

Crude enters the vessel through a 2-in. opening in the top and falls on the splash plate, which tends to atomize the crude and aid in the breakout of the lighter components. A stilling baffle provides a less turbulent fluid surface for the ball float, which actuates the pilot valve. A 2-ft. fluid depth is maintained in the vessel to provide retention time. A vacuum of approximately 1½-in. of mercury is needed to maintain the fluid level, and also helps to in-

TABLE 1—PERFORMANCE OF STABILIZING VESSEL INSTALLED ON 22-BBL. LEASE

	Average Daily Volume, M.c.f.	Specific Gravity	Test* gal./M.c.f.	Daily Test Gallons
Total lease gas before installing stabilizer	60	1.000	3.06	184
Gas from stabilizer	4.46	1.265	7.76	35
Total lease gas after installing stabilizer	64.4	1.040	3.40	219

*Refers to natural gasoline of 26-lb. R.v.p.

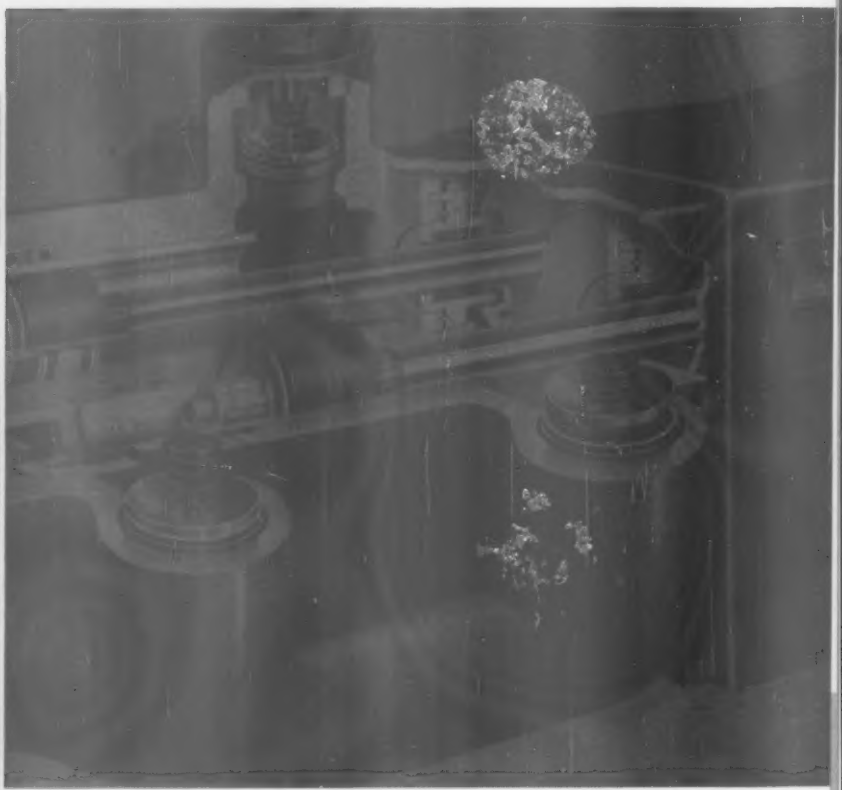
TABLE 2—PERFORMANCE OF STABILIZING VESSEL INSTALLED ON 230-BBL. LEASE

	Average Daily Volume, M.c.f.	Specific Gravity	Test* gal./M.c.f.	Daily Test Gallons
Gas from stabilizer	18	1.855	13.24	238
Gas from well casings	5	1.472	8.08	40
Gas from treater	19	1.608	6.08	116
Total lease gas	42	1.718	9.38	394

*Refers to natural gasoline of 26-lb. R.v.p.

put them all together

they spell higher pumping efficiency even when worn



The Mud Monarch® for high pressures lasts longer and does a better job to the very end. The important thing to remember about the Mud Monarch valves and seats is the exclusive seal ring. This seal ring is unaffected by wear on both valve and seat. There is no fluid slippage, no imperfect closing due to sand or foreign material. For low and medium pressure pumps, Mission Super-Service® and Silver Top® valves will last longest. Their heavy forged alloy steel bodies have high corrosion fatigue strength and are able to resist cyclic stresses set up by loading and unloading. The Compound 308® inserts offer greatest resistance to the chemical and abrasive effect of the fluid. For any pressure, any pump, Mission pump parts are the industry's first choice for longer life, less trouble.

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MISSION MANUFACTURING CO. P. O. Box 4209, Houston, Texas Cable Address "MISSCO" Export Office: 30 Rockefeller Plaza, New York
In the United Kingdom: MISSION MANUFACTURING CO., LTD., 1 Hanover Square, London W. 1 England • cable address "MISSOMAN"

crease the flashing or breakout of the lighter components.

The pilot valve, in addition to acting as a vacuum regulator, performs as a high-liquid-level shutoff valve, preventing any liquid being carried over into the vacuum gathering line. As the fluid level rises, with an increase in vacuum, the ball float rises and closes the pilot valve. The increase in pressure inside the vessel, resulting from vapors flashing out of the incoming liquid, lowers the fluid level and discharges a portion of the fluid through a 2-in. outlet connection to the stock tanks. When the fluid level is thus lowered approximately 1 in., the pilot valve opens and vapors are liberated to the vacuum gathering line. The vapor space in the vessel is again subjected to an increasing vacuum, starting another cycle of operation. Observations of these vessels in actual operation have shown that these cycles are controlled by a throttling action of the pilot valve.

The vessel is shown mounted on the deck of a stock tank and on the deck of a surge tank ahead of a lease - automatic - custody - transfer unit. The three screw-type legs with 6 by 6-in. load distributing pads can be adjusted to conform to the slope of the deck.

Mounting the vessel on the tank deck affords the most economical means of elevating the vessel. It must be above the top of the tank, so that when the vessel is operating at a slight vacuum the fluid level will be high enough above the top of the tanks to allow the oil to flow through the fill line into the top of the tanks, under gravity influence.

If desired, this vessel can also be made to operate at atmospheric pressure, when discharging to a vacuum line, by the installation of a vacuum-regulating valve in the vacuum line. In this arrangement the pilot acts only as a high-liquid-level shutoff valve.

When the stabilizing vessel is located and piped as shown, the normal operations of other lease equipment are not affected. Little or no maintenance is required for the operation of the vessel.

Installations to date have been made with the stabilizing vessel delivering gas into the vacuum line gathering systems. However, gas could be delivered into a low-pressure gas-gathering line, operating at 40 psi. or less, by using a small booster compressor unit.

Cost low. Average cost of the installation, including fabricating and installing vessel and connecting to vacuum gathering line system, has been less than $450.

Operating experience. Actual performance data covering 123 days of operation of one of these crude-oil stabilizing vessels on a producing lease are in Table 1. This lease produces 22 bbl. of oil per day. In addition to the crude-oil stabilizing vessel, gas is also gathered through vacuum lines connected to the well casings.

Based upon an installed cost for the vessel of $450, a payout of approximately 7 months was realized. The daily test gallons from the lease were increased from 184 to 219 all with the addition of only 4.46 M.c.f. of gas obtained from the stabilizing vessel. Also the liquid content of total lease gas was raised from 3.06 to 3.40 gal./M.c.f. with

"WHY PUT IN AUTOMATIC CHART-CHANGING AT ALL IF MY RECORDINGS WON'T BE ACCURATE?"

Good question . . . unless it's a Mullins Dial-O-Graph installation . . .

In automatic chart-changing, *how* the chart is recorded is important, too.

For example, unless the relationship of the chart plate and the stylus remains constant with the original calibration of the recorder, as each chart is recorded the thickness of the chart load can cause a variance of as much as 10 per cent in the graphs as plotted on the top, in-between, and bottom charts (see diagrams).

The Dial-O-Graph chart plate is spring-loaded, *thus moving each chart to the plane of the stylus' nominal point of contact with the paper.* The chart holding fixture on other devices, illustrated as Brand B in the diagrams, is on a stationary shaft, which causes the stylus to record out-of-calibration except on the last chart.

This is only one of many design refinements that make Dial-O-Graph superior to all other chart-changers. There are literally dozens more—too many to detail herein. Instead, let us send you our latest technical literature that describes all of the Dial-O-Graph features, and explains the many advantages of automatic chart-changing.

Whether you have one or a hundred recorders in your plant, the chances are that Dial-O-Graph will be worth your investigation.

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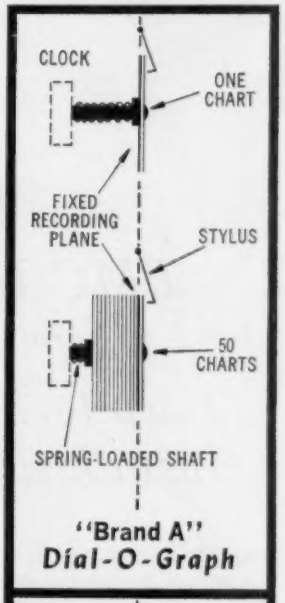
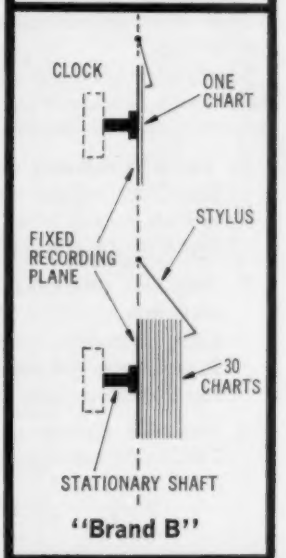
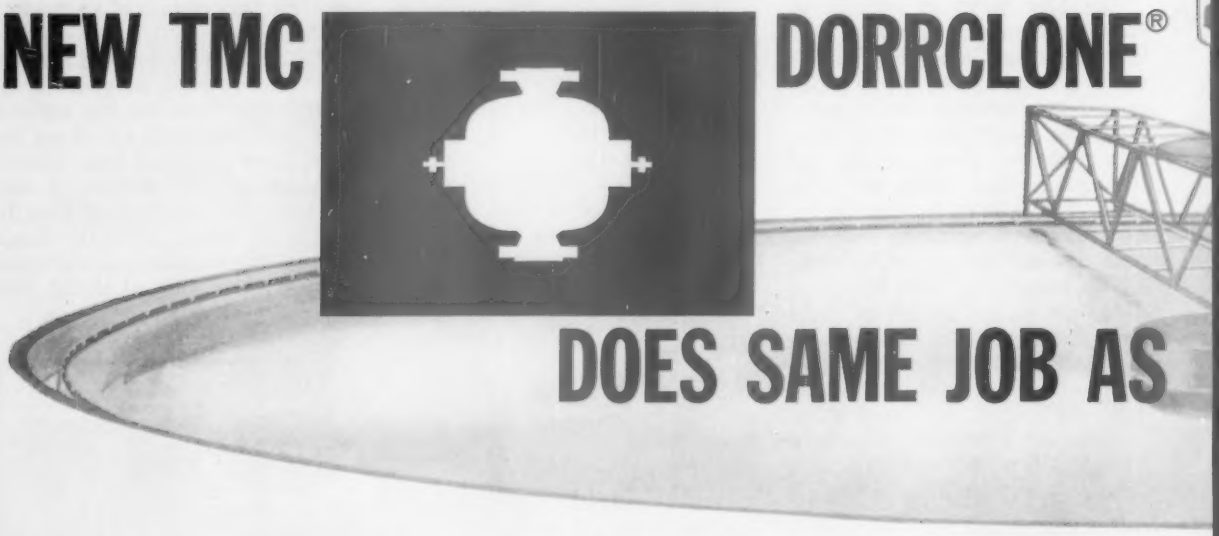




Diagrams illustrate how a stack of charts can affect the accuracy of the recording stylus.

From Dorr-Oliver...

NEW TMC DORRCLONE®



DOES SAME JOB AS

TMC DorrClone with midget manifolded cyclones handles entire bottom stream... up to 10,000 bbls/day in new or existing installations... can pay for itself in a month!

The TMC DorrClone is a major new tool for refinery processing. Initial installations prove beyond question that it offers sensational opportunities for important cost savings.

The specific advantages of the TMC DorrClone, compared with thickeners or cone bottom settlers, are numerous and substantial. Briefly –

1. **You save valuable space** . . . When a 3 foot TMC DorrClone occupies only about 7 square feet, there is little reason to tie up more than 1250 square feet with a thickener 40 feet in diameter.
2. **You can raise the capacity of most crackers materially** . . . The TMC DorrClone concentrates solids to 45-50%, compared with the normal 10%. This reduces the amount of cracked oil recycled, and thereby reduces carbon formation.
3. **You save directly on catalyst cost** . . . for the TMC DorrClone eliminates up to 99.5% of the fine particle carryover commonly contained in the thickener (or decanter) effluent. Reclaimed catalyst can be returned to the reactor.
4. **You work under conditions of greater safety** with the TMC DorrClone . . . Construction is completely closed. There are no spills, no boil-overs, no danger of fire or explosion.
5. **You save on maintenance** . . . because you largely eliminate the need to dig out settled solids in the fuel oil tank.

Whether you are planning to replace your present thickeners or cone bottom settlers, or are equipping new FCC units . . . investigate. Let refinery-experienced Dorr-Oliver engineers help you evaluate the TMC DorrClone for your operation.

Look into the savings you can make. Write to Dorr-Oliver Incorporated, Stamford, Connecticut.

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WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

3 FT. DIA.!

THICKENER 40 FT. DIA.!

The TMC DorrClone is designed around compact, long-life, midget aluminum oxide cyclones, manifolded in groups in parallel. In this exploded view, a number of the cyclones have been removed to permit a clearer view. Inserted blanks can adjust capacity. All cyclones operate alike, and each clarifies approximately 30 bbls/day. Clarified oil under high centrifugal force swirls to the center of each cyclone, flows up and out. Solids flow helically down the tapered side of the interior and out. Particles are classified at approximately 5 microns.

SPECIFICATIONS	TMC-60	TMC-180	TMC-300
Capacity, bbls/day	1000-2000	4000-6000	7000-10000
Height, inches	17	24	30
Diameter, inches	22	32	40
Weight, lbs. (approx.)	1100	1800	3000
Pressure, psig	150	150	150
Temperature, °F.	850	850	850

TO: DORR-OLIVER INCORPORATED
STAMFORD, CONNECTICUT

Attn.: Mr. O. W. Johnson

☐ Please send me more information on the TMC DorrClone.

☐ Please have sales representative call.

Name_____

Title_____

Company_____

Address_____

City_____ Zone_____ State_____

"Twice the service we would expect . . ."
"After 19 months, the core of our UNI-CORE Sand Line was in good shape. Gave nearly twice the service we would normally expect before the wires began to wear."
—Texas well servicing company

"We Gave it the Acid Test . . ."
"Where acid was being used in our wells, plastic core, Union cable tool drilling line outlasted other brands. We also use Union Sand Lines with plastic core and they are doing an outstanding job."
—Illinois tool pusher

It Pays to Listen

Here's what they say about UNION'S UNI-CORE® cable tool and well servicing lines

New steels are born at Armco

UNI-CORE Service Line
Photo of a section of UNI-CORE Sand Line showing plastic core. Engineered to resist heat, acids—other enemies of long core life.

UNI-CORE Cable Tool Line
Developed to give the same outstanding performance in cable tool drilling as Union's UNI-CORE well servicing line.

"Rough duty since Dec., 1960 . . ."
"We gave UNI-CORE the works in servicing wells 10,000 feet and deeper. We check the line constantly. It has shown no breaks and has not pulled down in any place. No other make has given us such service."
—Oklahoma well servicing company

"We get better wear . . .
out of our UNI-CORE Sand Lines than any we have ever used. We bought Union cable tool line on the basis of our sand line service."
—W. Va. tool pusher

Here's first-hand proof from the field. Read what the tool pushers and the oil well servicing people themselves think of UNI-CORE.

They're getting greatly lengthened service, less down time and saving money through safe, efficient wire rope performance.

UNI-CORE Sand Line is the wire rope with the plastic core instead of fibre or wire. It is designed for the special needs of oil well servicing. It has superior resistance to compression, elongation, heat, acids and salt water — the natural enemies of long wire rope life. Cable tool pushers are getting the same superior service from UNION'S UNI-CORE Cable Tool drilling lines.

For quality wire rope for every need in the oil industry, call any leading oil field supply store or write: **Union Wire Rope, Armco Steel Corporation, 2102 Manchester Avenue, Kansas City 26, Mo.**

ARMCO Union Wire Rope

Next Week:

Drilling the modern way

FOCAL POINT of the Journal's annual drilling number of October 2 will be an extensive report on selection, operation, and maintenance of drill collars.

Another important feature of next week's issue will deal with the new concept of optimum drilling rates—those rates which drill the most hole for the money.

The annual drilling number also includes a summary of drilling costs and conditions in approximately 100 active drilling areas in the U. S. and Canada.

Watch for these important drilling features in next week's Oil and Gas Journal.

the addition of the rich gas from the stabilizing vessel.

Listed in Table 2 are performance data for a stabilizing vessel installed on a lease producing 230 bbl. of oil per day. Here, in addition to the crude-oil stabilizing vessel, gas is also gathered from the treater and through vacuum lines connected to the well casings. This vessel has been in operation for 157 days. The data shown cover operations during cold weather. The volume of gas from the stabilizing vessel has been as high as 22 M.c.f. per day during warmer weather.

It is interesting to note that of the total gas gathered from the lease, 18 M.c.f. or 43% is supplied by the stabilizing vessel. The liquid content of the stabilizer gas is much higher than that of the gas from either of the other two sources. The liquid content of the total lease gas has been substantially increased, indicating that the total lease gas has been enriched by the addition of the gas from the stabilizer. The daily test gallons of liquids are greater for the stabilizer gas than for the treater or casing-head gas.

The revenue from the stabilizer gas resulted in a payout of approximately 1 month for the stabilizer installation cost.

The largest volume of gas recovered to date from one of these small vessels has been 35 M.c.f. per day. This vessel is on a lease producing 60 bbl. of oil per day.

Crude-oil stabilization can be profitable on small leases, resulting in quick payouts of small investments with practically no maintenance expense. In addition, good conservation is practiced by collecting and conserving valuable light components of crude oil that are usually wasted to the atmosphere by weathering in lease stock tanks.

it's powered by a
37-hp WISCONSIN
FOR THIS APPLICATION the VG4D Wisconsin Engine is equipped with electric starter-generator, 2.5:1 clutch reduction. Machine is made by Crose-Perrault Equipment Corp., Tulsa, Oklahoma.

unit coats and wraps as it travels along 24" pipe

The unit shown speeds one of the toughest jobs in the oil fields. Powered by a 37-hp VG4D Wisconsin Engine, the travelling machine coats and wraps 24-inch pipe against corrosion breakthrough in one cost-cutting run. Hot pipe enamel is tubed to the coating shoe of the unique dope plant from a heating kettle which moves alongside the machine. The Wisconsin-powered unit applies the coating and then wraps the pipe with either glass wrap, felt, or slant or kraft paper as it power-crawls along the line.

The rugged VG4D fits the job to a T. Being air-cooled, it is much lighter and more trouble-free than its water-cooled equal. It has no radiator, water pump, fan belt, and hoses to weigh down the machine — nor to become fouled by dirt and excess heat. Air cooling also cuts servicing and upkeep.

See us for utility units. Above all, let us tailor the heavy-duty air-cooled Wisconsin Engine for your equipment or job. Sizes 3 to 56 hp. Send for Bulletin S-249.

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MOTOR CORPORATION
Milwaukee 46, Wis.

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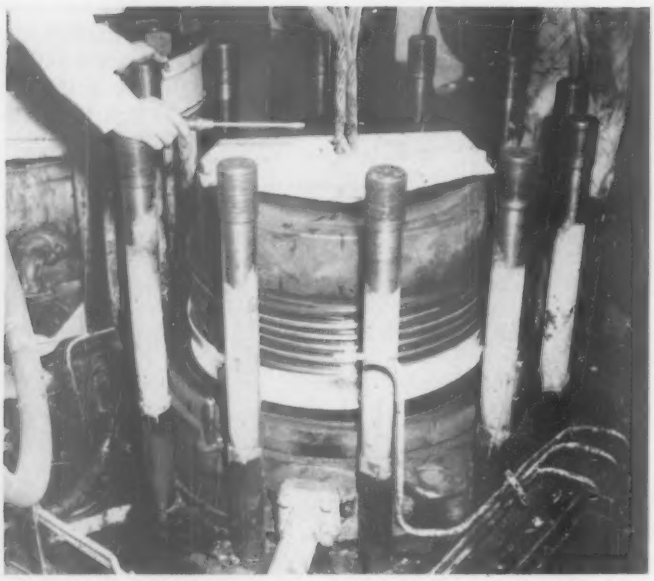
Oil Field Distributors for Wisconsin Engines and all types of Utility Units

World's Largest Builders of Heavy-Duty Air-Cooled Engines

J-304

Processing notes

ENGINEERS use extended ring expanders to carry radioactive piston ring to engine room of ship.



"HOT" RING, at top of piston, throws off radioactive particles which are traced through lube oil to determine engine wear.

"Hot" piston ring checks ship's lube performance

OIL SCIENTISTS are using a radioactive piston ring aboard the motor ship Frances Salman to tell them how good a lubricating job their oil is doing.

Engineers of Standard Oil Co. of California have installed an irradiated ring on one of the six pistons of the ship's diesel engine. The 30-in.-wide, 30-lb. ring is the largest ever irradiated.

The scientists are tracing radioactive particles from the ring in the ship's lube-oil system. Radioactive traces also are filtered out of the exhaust system. Information obtained from the radioactive material will determine piston wear of different fuels, oils, and additives. Standard of Cal expects to study the operations of the ship for 6 to 8 months.

The company picked the Frances Salman because it is equipped with a Swedish Gotaverken engine with a 5,700-hp. shaft. This is popular throughout the world, so results can be used internationally.

Radioactive rings are standard equipment in most oil-company research laboratories. The companies use them to study engine wear in automobiles.

Researchers fight bacterial contamination

BACTERIA THRIVE on petroleum or its products wherever moisture is present in the ground, in storage, or in vehicle tanks. These bacteria feed on the fuel, for the most part at the interface between the fuel and free water.

However, studies show that bacteria can exist in hydrocarbons without the presence of free water, according to Dr. R. J. DeGray, a senior research associate with Standard Oil Co. (Ohio).

His report, presented to the Society of Industrial Microbiologists, is based on 19 samples, all of which contained no more than 0.01% water saturation; no free water was present in the storage containers.

Microbiological life was shown by adding free water or sterile broth to the stored samples. Since the majority of samples showed life, these bacteria had obviously lived in closed and dry petroleum products for about 6 months prior to this evaluation.

That life exists in anhydrous hydrocarbons is of more than academic interest. For instance, in the handling and storage of jet fuel, the role of microorganisms as trouble makers has long been rec-

ognized. The industry must meet rigid specifications for jet-fuel cleanliness. It has done this by using filtering and washing systems. At the same time the aviation industry has adopted, as widely as possible in a practical way, its own methods for housecleaning.

Even so, the problem still exists. Filters cannot catch the minute bacteria and spores, which continue to exist in the anhydrous fuel. The bug population explodes when moisture is introduced into the fuel system. This automatically happens when moisture in the air condenses in the fuel tank due to the lowering of temperature and fuel level.

Organisms in the hydrocarbon phase transfer to the water phase or the interface and grow rapidly. Products of this bacterial development change the moisture layer so that it attacks the lining of the fuel tank and the tank itself more easily. Thus, a major problem actually involves corrosion as well as bacteria clogging the fuel lines.

Experts differ in their approach to a solution of the problem. Some research is directed toward additives which will kill the bacteria. Others believe that fuel composition is the answer; determine why some hydrocarbons halt the growth of bacteria.

Dr. DeGray's work shows that intensive drying of the fuel kills the bacteria. Too, he is working with a boron-containing biocide, a trace of which in the fuel prevents these troubles. No bacteria or fungi have yet been found that will adapt to it.

Additional research is under way in the labs of several major oil companies and research organizations. And, earlier this year the Coordinating Research Council began a study of the extent of the bacterial problem.

Cyclohexane plant designed with computer control in mind

THE FIRST FACILITY to manufacture cyclohexane from benzene using the new platinum-containing Hydrar catalyst has been placed on stream by Continental Oil Co. at its Ponca City, Okla., refinery.

It marked not only the use for the first time of one of the newer processes for hydrogenating benzene to cyclohexane, but Conoco's first use of electric control at the Oklahoma refinery.

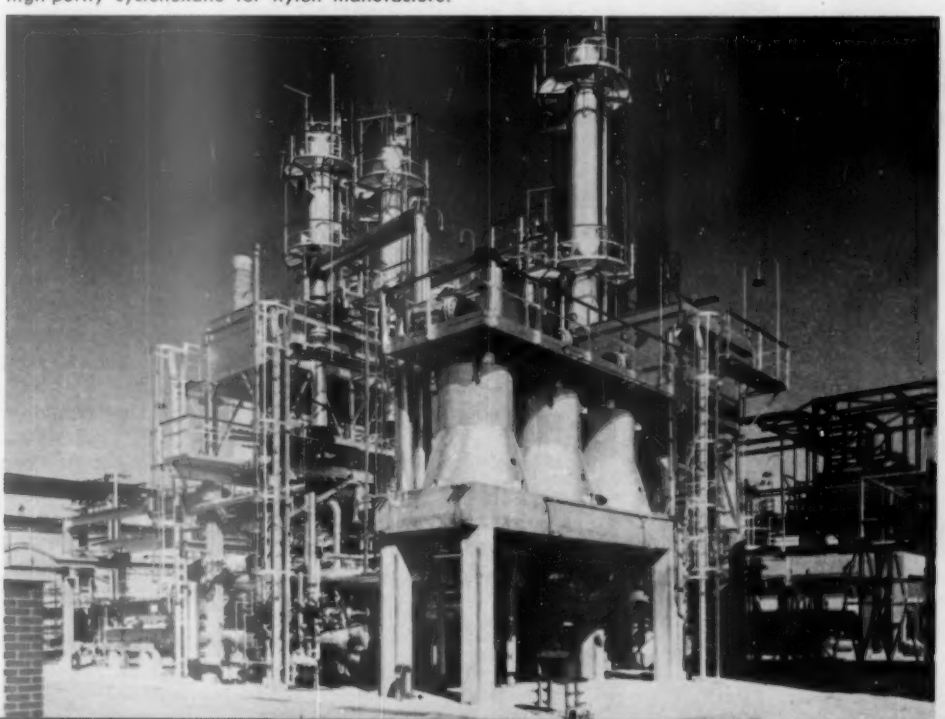
Two considerations prompted the specifying of electric equipment: precise control and lack of a "dead" zone characteristic of this type of instrumentation, and compatibility with computers. With process computers gaining in stature, compatibility of system components becomes an important factor in long-range plans.

Process. Conoco produces approximately 1,800 bbl. per day of high-purity cyclohexane, an important intermediate in making cyclohexanol, cyclohexanone, adipic acid, caprolactam, and nylon. Conoco's output is sold to nylon manufacturers.

Hydrogen for the process comes from catalytic reformers. It is treated in an amine absorber and a caustic wash system for removal of hydrogen sulfide and then put through an oil-absorption process for removal of heavy hydrocarbons. Next, the treated hydrogen is combined with benzene and passed through a bed of solid platinum-containing catalyst. The reaction produces cyclohexane. Final step is the removal by means of a stabilizer, of propane and butane traces from high-vapor-pressure cyclohexane.

Instrumentation for the Hydrar unit consists of 22 miniature strip-chart recorders, an indicating manual flow controller, and five pneumatic level indicators, all panel mounted; field-mounted two-wire transmitters, and valve actuators. Instruments were supplied by Minneapolis-Honeywell Regulator Co.

HYDRAR UNIT at Continental Oil's Ponca City, Okla., refinery produces about 1,800 bbl. per day of high-purity cyclohexane for nylon manufacture.



Here's how early distillation processes operated

Three distillation processes separate fractions within liquid mixtures. These are: batch shell stills, continuous shell still, and fractional distillation.

THE BEST WAY to illustrate the application of principles of distillation is to retrace a simple distillation procedure.

- First, the liquid mixture must be heated sufficiently to get it partially vaporized. This occurs when the vapor pressure of the mixture equals the external pressure on the mixture.
- Vapors produced will be richer in the lightest boiling material present in the feed stock than the feed itself because of the lightest boiling material's higher vapor pressure.
- Condensation of the vapors gives a liquid condensate richer in lightest boiling materials than the liquid from which the vapors were derived.
- By repeated vaporization and condensation steps, the degree of separation (quality improvement) between the different boiling-point fractions can be increased.

This material taken from process-training-program manual, Bayway, N. J., refinery of Humble Oil & Refining Co.

Distillation Processes

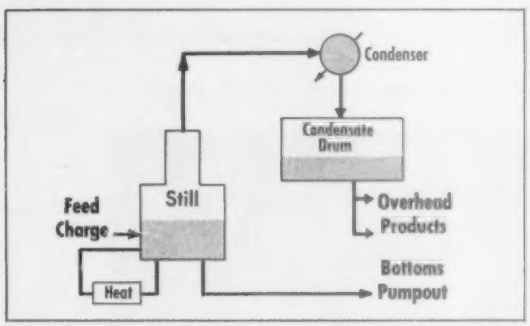
Since the beginning of refinery operations, three types of distillation processes have been used to separate fractions within liquid mixtures. These are: batch shell stills, continuous shell still, and fractional distillation.

The major process used today is fractional distillation, with very little use being made of either the batch of continuous shell still processes. However, as fractional distillation is nothing more than an extension or "modernization" of the older two processes, it is necessary to review the batch and continuous shell-still operations first.

Batch shell still. In this operation, (Fig. 8) a set feed charge was made to the still. The temperature of the feed was then raised in a stairstep fashion. The overhead products obtained during each stairstep rise in temperature were then segregated. When the contents of the feed vessel were heated to the maximum desired temperature, the remainder of the feed charge (bottoms) was pumped out, and the still allowed to cool.

A fresh feed charge was then made, and the heating and collection-of-product cycle repeated. On a commercial scale, it was a very time-consuming, inefficient operation. In addition, the separation of components from a quality standpoint was very poor.

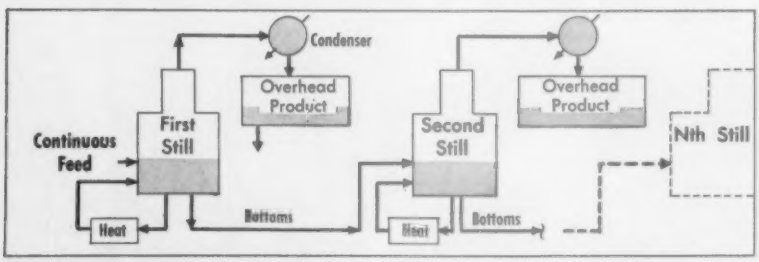
As the demand for products increased, it became necessary to devise a means of increasing output and product quality. This demand led to the development of the continuous shell-still process.



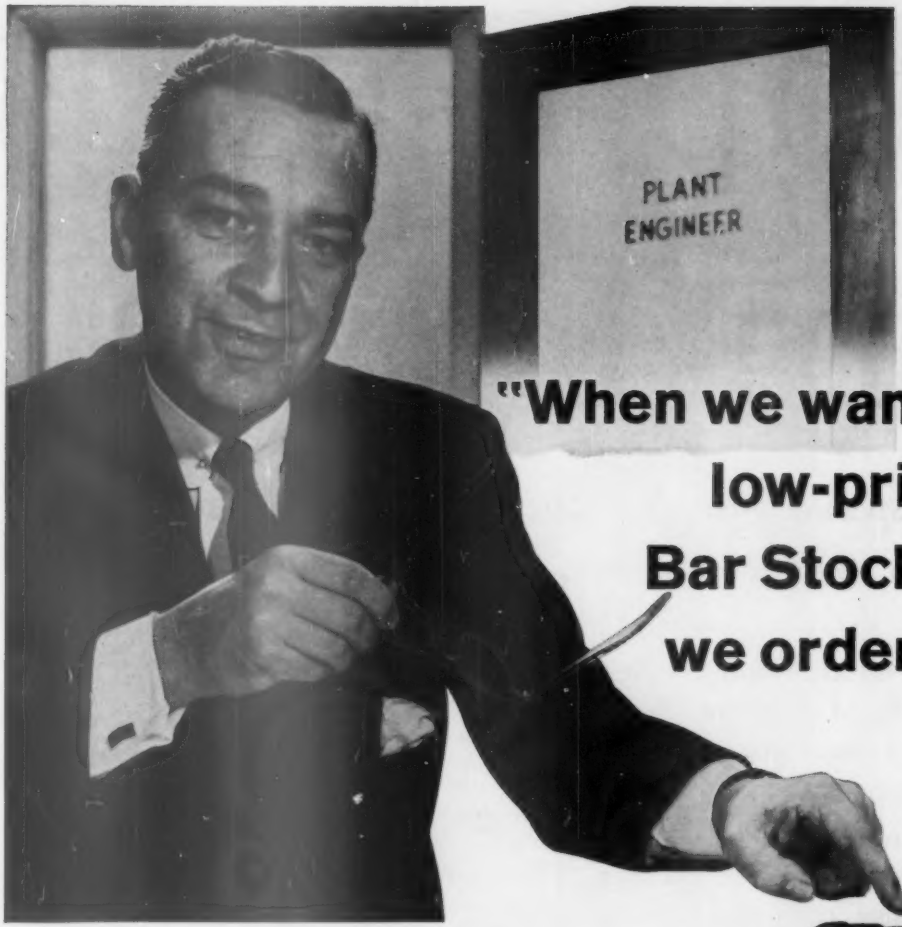
BATCH SHELL STILL was one of the earliest processes used to separate liquid mixtures. Fig. 8.

Continuous shell stills. This operation (Fig. 9), consisted of nothing more than a number of shell stills hooked in series to form a battery. Fresh feed was fed continuously to the first still. The temperature of the first still was held lowest, the temperature on the second still a little higher, and so forth.

Thus, the lightest (lowest-boiling) overhead product was taken off the first still, the next-highest-boiling material off the second still, and so forth. The minimum number of stills in the battery, of course, depended on the number of product cuts desired. Provided there was no change in quality of the feed stock or still temperatures, the product obtained from each still was of relatively constant quality.



CONTINUOUS SHELL STILL was a refinement of the batch process. It consisted simply of hooking the batch stills in series. Fig. 9.



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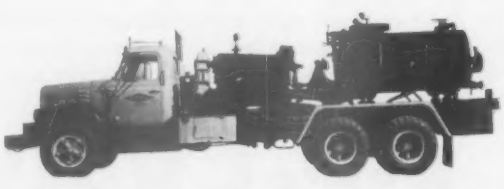
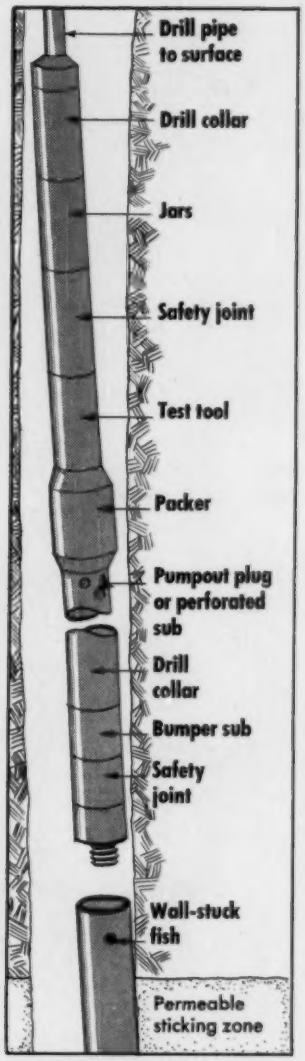


DOWELL "TP" PUMPER. 175 hydraulic horsepower rated output. Pressures up to 10,500 psi. Volumes up to 828 gpm.

DRILL-STEM-TEST PACKER is readied to go through the rotary to retrieve a string of wall-stuck drill collars. Spotting oil in the hole failed, so free-point indicator was run and the pipe backed off with string shot.



TYPICAL downhole assembly for retrieving a wall-stuck string with a DST tool. Test pool opens when packer sets.

DST tools help Rocky Mountain drillers free stuck pipe

An old problem turns up in a new place as Rocky Mountain drillers discover that many of their stuck strings, once blamed on other causes, are actually wall stuck. Success has followed use of drill-stem-test tools, when spotting oil in the hole has failed to free the strings.

BY ED McGHEE
Drilling Editor

THERE'S BEEN quite a commotion in recent months about the seeming epidemic of wall sticking of drill strings in coastal Louisiana, Texas, and California. Drillers in these areas have only lately learned to diagnose this newly recognized ailment. And now they seem to be having a regular plague of it.

Through all the excitement, the coastal drillers were inclined to envy

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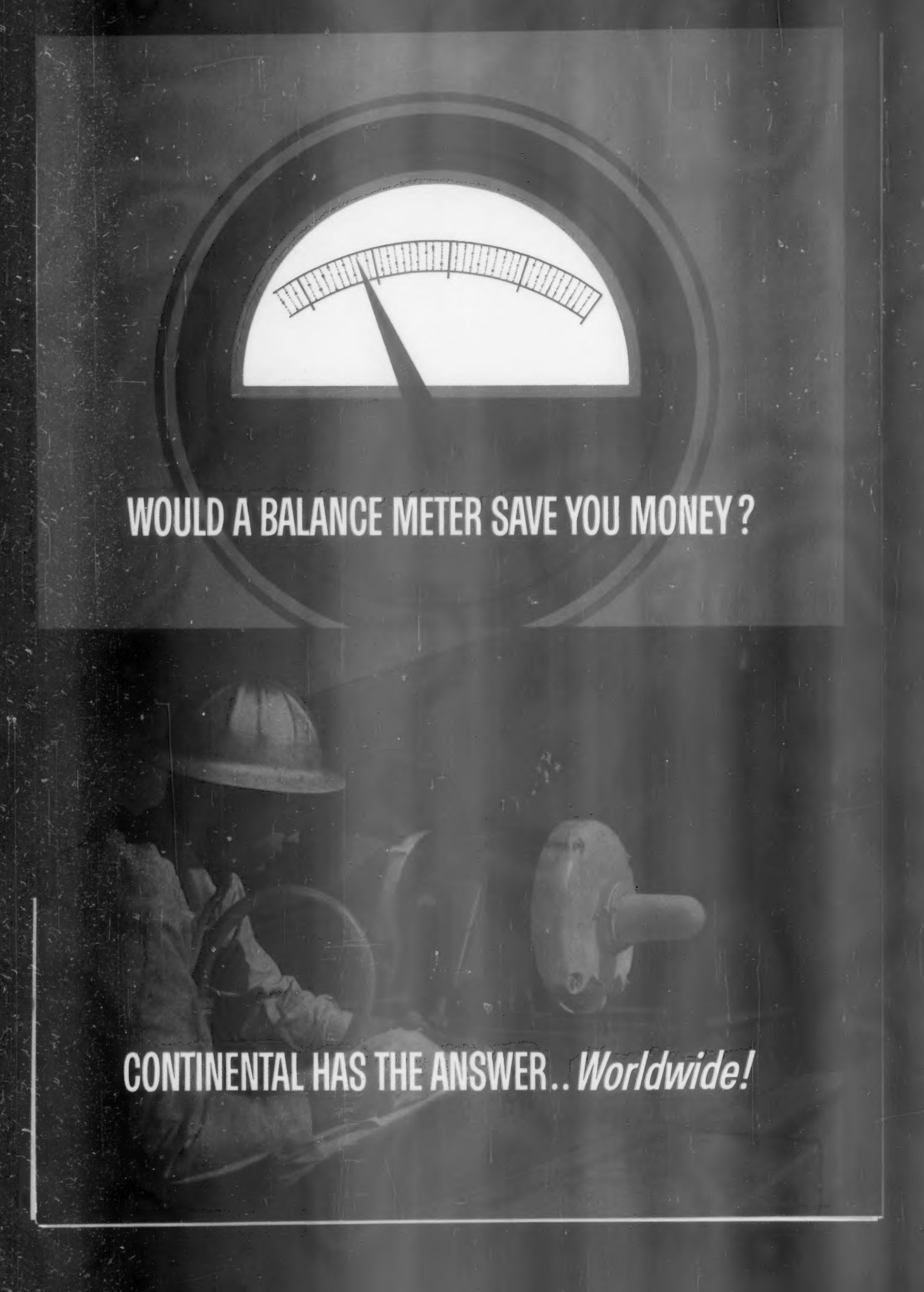
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"Once free, the fish have shown no tendency to stick again."

those working in the Rocky Mountains. Many reasoned that the Rockies should be immune to this fashionable disease which seemed to be a secondary infection resulting from use of high mud weights.

But it was a case of misreading the symptoms. The Rocky Mountain drilling contractors have proved their area is infected too; most now agree that a lot of the drill strings stuck in Rockies wells are actually wall stuck. Or, to use the technically correct term, it is "differential-pressure stuck." Most of the sticking is at medium depths (5,000 to 8,000 ft.) with muds lighter than 11 lb. per gal.

Evidence to support this diagnosis is strong: in many cases the stuck strings can be freed by using drill-stem-test (DST) tools to relieve the pressure differential.

The DST-tool "cure" has been prescribed in perhaps a dozen wells in Wyoming, North Dakota, and Montana; success ratio is estimated at better than 75%.

The old home remedy, spotting a dose of oil in the hole, is still being applied. But results aren't always good. Thus far, none of the new cures, chemical pipe "looseners," have been tested.

The preventatives, spiral-groove collars, e.p. lubricants, stabilizers, surfactants, remain to be tried if wall sticking proves more common than drillers now suspect.

Direct to the cause. No method of treating a wall-stuck string goes so directly to the root of the problem as does a DST tool. The string sticks because pressure inside the borehole is greater than in the sticking formation. The DST tool reverses that situation. It reduces pressure in the hole almost to zero—less than in the sticking formation.

Here is how drilling contractors in the Rockies use the DST method of freeing wall-stuck pipe. After the string becomes stuck, they look for these signs that indicate wall sticking:

1. Did the string stick after remaining motionless in the hole for a time?

2. Can circulation be broken and continued through the string at normal pressures?

3. Is there a permeable formation open to the well bore where the string extends? Such a formation may have been causing "seepage" loss of the drilling mud.

4. Is the hole known to be relatively clean and in good condition?

If the answer to these questions is yes, then wall sticking is a virtual certainty. First step, then, is to try to free the string by spotting oil in the hole; usually, this is sufficient to free the string. If not, a free-point indicator is run to locate the depth at which pipe or collars are stuck. Then, a string shot is run, the pipe is backed off above the stuck point, and the free pipe pulled. As soon as possible, a new assembly is run in to engage the fish.

The new assembly, beginning at the bottom, ordinarily contains these components:

1. A safety joint so that the fish can be released if not recovered.

2. One or two bumper subs to help in knocking the fish free.

3. A drill collar to give weight above the bumper subs. Some do not include this collar.

4. A perforated sub or a pump-out-plug sub (with plug out) so that there is communication between the inside of the string and the hole annulus below the DST packer.

5. The test-tool packer which packs off when weight of the string above is set down on it.

6. The test tool itself which opens automatically when the packer sets.

7. A safety joint to release the string above should the packer become stuck. Some do not include this safety joint.

8. A set of jars to be used to help free any of the assembly or fish below.

9. Drill collars to supply weight to set the packer and to aid the jars. Some do not include these collars but use drill pipe instead.

10. Drill pipe to the surface.

The above assembly is screwed into the fish, weight of the string is set down to set the packer, and the test tool opens automatically. In almost all cases thus far, the stuck pipe has fallen free in a few seconds. As the pipe comes loose, its weight is thrown onto the string above, the DST packer collapses,

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and the weight indicator shows that the fish is now suspended from the hook.

Signal Drilling Co. reports one of its wells on which the fish did not fall free immediately. However, after a wait of about 5 minutes, the derrick shook and the weight indicator registered the additional load to show the fish had fallen free and was now hanging on the fishing string.

Once free, the fish have shown no tendency to become stuck again. Most contractors, however, begin pulling them out immediately so that there's little time for the string to become stuck a second time.

As deep as 9,000 ft. Atlantic Refining Co. is generally credited with the first field trial in the Rockies of the DST-tool method of freeing wall stuck pipe. The company was coring a well near Dickinson, N. D., when the core barrel stuck a few feet off bottom after the rig was shut down a short time to make repairs.

Indications were that differential-sticking was to blame. So Atlantic backed off the string and ran a DST-tool assembly. Immediately after the tool opened, the fish dropped free and was recovered without incident.

Probably the next trial was on a Texaco Inc. well in Big Wall field near Roundup, Mont. The string stuck in a permeable zone just below intermediate casing. It had stuck after being motionless for a few minutes and mud circulated at normal pressure. Since there was no evidence of other trouble, the company suspected wall sticking.

After the free pipe was backed off, a DST tool was run and the fish recovered quickly.

A later Texaco well successfully recovered with a DST tool pipe which had been wall stuck below 9,000 ft.

The symptoms. Usually, a string of collars becomes wall stuck only after being at rest for a time. Apparently it takes some time for the string to become imbedded in the wall cake so that it is held too tightly to be pulled away. This isn't always the case, however. Signal Drilling had one well in which the collars stuck while being pulled upwards off bottom at slow speed.

It is certain that wall sticking was to blame because the collars were easily freed by the DST-tool method.

Rocky Mountain contractors now run large or "oversize" collars more frequently than in the past. Opinion is divided on whether big collars become wall stuck more readily than do small ones; some think that in the big collars lies the explanation for the emergence of wall sticking as a major drilling problem in the Rockies.

In any case, it's a mistake to think that only big collars become wall stuck. Not only small collars but also drill pipe can differential-pressure stick. One contractor reports a case where he ran a mixed string of collars, several large collars on bottom with a number of smaller ones above. The string became stuck. The free-point indicator showed it was the smaller collars—not the larger ones—which stuck.

This string was recovered by running a DST tool; obviously wall sticking was to blame.

The contractor has what seems a plausible explanation for the small collars sticking in a section through which the larger collars had already drilled. He cites the fact that mud velocity around the big collars is much higher than around the smaller ones. It may be, the contractor says, that the higher velocity kept most of the wall cake scoured off the hole walls next to the big collars. As a result, there was less chance for the big collars to embed themselves in filter cake.

The small collars probably worked in a portion of the hole where there was more wall cake. As a result, they could become embedded and stuck.

Since wall sticking is associated with permeable zones on which there may be a thick wall cake, some tend to blame poor muds as a cause. Experience hasn't borne out this theory. Strings have been wall stuck even when using what are normally considered good muds for the Rocky Mountains. Water losses have been as low as 6 to 10 cc. and viscosities down in the 50 to 60-cp. range.

There haven't been enough data gathered to say whether muds containing oil are any less likely to stick than straight water muds.

History of success. One Rocky Mountain drilling superintendent recalls that he first heard of the DST

"It's a mistake to think that only big collars become wall stuck"

method of freeing stuck pipe back in Oklahoma. A drilling contractor stuck his pipe while drilling a formation known to be a producing oil zone. The contractor, of course, was aware that the common method of attempting to free pipe was to spot oil in the hole. So he reasoned that he should run a DST tool in the hole, catch the fish, and then open the tool. This would cause oil to flow out of the formation into the hole. Perhaps it would help free the pipe.

So he tried the DST method. It worked. But, not for the reason he thought.

Later on, personnel of Shell Oil Co. analyzed the wall-sticking principle in California. The company had been plagued by strings sticking when attempting to drill through old depleted oil zones. Finally someone suggested a drill-stem-test tool as a good way to free such strings. The rest is history. The DST method worked and thereby proved that wall sticking is not only possible but also a frequent occurrence.

A close student of wall sticking in the Rockies, Bill Dahlem, of Magcobar Mud Co., makes this observation about freeing stuck pipe by spotting oil in the hole:

"Where oil was successful in freeing the pipe, it was only after the oil had been pumped slowly into the annulus and above the point of sticking. It may have been that the long period of soaking accounted for part of the success. But at the same time, the oil in the annulus above the stuck point was reducing the hydrostatic pressure there. Thus, the oil weighing less than the mud did, was cutting down on the pressure differential."

Dahlem also says that in almost every case his company studied, there were permeable beds drilled within 200 to 300 ft. above the bottom of the hole. In several wells, the pipe stuck when picked up a few feet and left motionless in order to treat the hole for a seepage of drilling mud with fine lost-circulation material.

Not mud weight alone. If a driller is to be able to recognize when the drill string is wall stuck, he must understand exactly what causes the condition. To explain wall sticking, one contractor uses the example of the wash cloth left in the bath water after the plug is pulled. The loose cloth is soon sucked into the drain and held there tightly. It takes a good tug to pull the cloth loose.

What holds the cloth? Differential pressure. The pressure of the water above is greater than in the drain.

The same principle applies in drilling a well. Pressure in the well bore (caused by the standing head of mud) is higher than pressure in the formation at that point. This must be true; otherwise the well would blow out. The difference in pressure (or differential pressure) is what causes wall cake to accumulate on the face of a permeable formation.

When a drill collar comes to rest against the face of such a permeable formation, we might think of it as if it were a big "particle" of the filter cake. Pressure on the mud side of the collar is high; pressure on the formation side is low. If there is enough difference in pressure and if the permeable section is long enough, the collar becomes too tightly stuck to be pulled away or to be rotated.

It is important to note that the mud weight doesn't have to be 15 lb. per gal. or 18 lb. or even 10 lb Mud weight has only to be significantly higher than formation pressure. Think of drilling in an old field where the hole must pass through a thick sand which has been produced so long its rock pressure is practically zero. It might be possible to drill such a hole without losing circulation. But the pipe could become wall stuck even if drilling with water or oil.

Notice also that there is nothing to restrict circulation when the string is wall stuck. The hole need not have caused drag on the pipe during trips in order for wall sticking to occur.

Acknowledgment

Credit is due the following individuals who furnished much of the information contained in this article: Paul Robertson, Signal Drilling Co., and Bill Dahlem, Magcobar Mud Co., both of Casper, Wyo.

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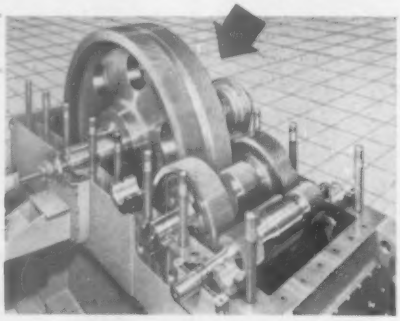

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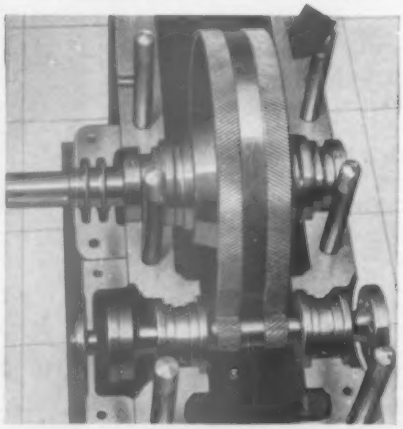

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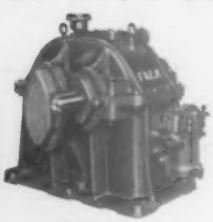

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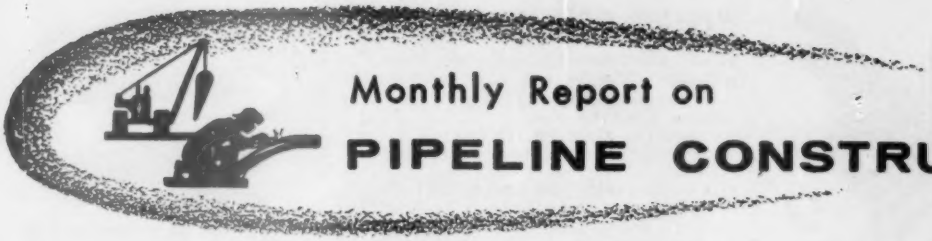


Monthly Report on PIPELINE CONSTRUCTION

PIPELINE ACTIVITY reported here is compiled from surveys by The Oil and Gas Journal among pipeline companies and contractors.

This summary appears in the last issue each month. New projects are reported weekly under Pipeline Briefs.

Projects are listed in three groups—U. S., Canadian, and Foreign—and according to type of line—crude, products, natural gas, or miscellaneous.

★ The star symbol indicates the first appearance of the project in the Journal's survey.

U. S. Crude Oil Pipelines

ASHLAND OIL & REFINING CO., Ashland, Ky.
Project: 24-mile, 6-in., from Blaine, Ky., to Catlettsburg, Ky.
Completion: Oct. 1, 1961.
Contractor: Cumberland Construction Co.

CONTINENTAL PIPE LINE CO., Drawer 1267, Ponca City, Okla.
Project: 4-mile, 3-in., 18, 4-in., 68, 6-in., 323, 8-in., and 53, 10-in., Glacier System from Cutbank, Mont., to Byron, Wyo.
Status: Under way.
Contractor: R. H. Fulton & Co., Lubbock, Tex.
Completion: Feb. 1962.
Project: 20.7-mile, 8-in. crude line from Grand Isle to Golden Meadow, La.
Completion: December 31, 1961.
Contractor: Glaser Construction Co.

GILLETTE PIPELINE, INC., and A. W. HARTWIG, INC., Billings, Mont.
Project: A 102-mile line from Dead Horse Creek field to Casper, Wyo.
Status: Pending Wyoming Public Service Commission approval.

GREAT NORTHERN PIPE LINE CO., 175 East 4th St., St. Paul 1, Minn.
Project: 64-mile extension to the Lignite field, Burke County, North Dakota.
Status: Planned for 1961.

HUNT OIL CO., Houston, Tex.
★ Project: 36-mile, 3-18-in. gathering system, North Tioga area, North Dakota.
Status: Under way.
Contractor: Curran & Co.

KERR-McGEE OIL INDUSTRIES, INC.,
Completion: Nov. 30, 1961.
Oklahoma City, Okla.
Project: 10 miles, 2, 6 and 8-in. gathering lines, Pinta Dome field, Arizona.
Completion: Nov. 1, 1961.
Contractor: Northwest Construction, Inc.

MATADOR PIPE LINE CORP., Denver, Colo.
Project: 175-mile line from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man.
Status: Approved by CNEB.
Completion: Dec. 31, 1961.

MID-CONTINENT PIPE LINE CO., Tulsa.
Project: 9-mile, 6-in. crude oil line from Crider field to Maysville station, Okla.
Status: Planned.

NORTHWESTERN REFINING CO., Box 248, St. Paul Park, Minn.
Project: 4, 6, and 8-in. gathering lines in Glenburn field, Renville and Bottineau counties, North Dakota.
Status: Has state approval.

OVERLAND PIPELINE INC., Wichita, Kans.
Project: 4-in. gathering system in Lone Tree field, Wyo., and transmission line to connect with Plains Pipeline Division of Franklin County Coal Corp.
Status: Application before Wyoming PSC.

SERVICE PIPE LINE CO., Box 1979, Tulsa, Okla.
★ Project: 60-mile, 8-in. from Big Piney field to Granger, Wyo.
Status: Under way.
Completion: Nov. 1, 1961.
Contractor: O. R. Burden Construction Co.

SHELL PIPE LINE CORP., Box 2648, Houston 1, Texas.
Project: 25.3 miles, 6-in., 2.2 miles, 4-in., Conley field to South Vernon Junction.
Completion: Third quarter, 1961.
Contractor: Flint Rig Co.
Project: 7-mile, 2-in., Sealy gas plant to Hope Houston line.
Completion: Third quarter, 1961.

SINCLAIR PIPE LINE CO., Independence, Kans.
Project: 170-mile, 8-in. from Stockholm to Panova, Okla.
Completion: Sept. 15, 1961.
Status: Under way.
Contractor: R. H. Fulton & Co.

TETON PIPE LINE CORP., 1700 Broadway, Denver 2, Colo.
★ Project 10 mile, 4-in., Osage field to Osage station, Platte Pipe Line.
Completion: October 1961.

U. S. Products Pipelines

AMERICAN PETROFINA CO., Rockefeller Center, New York, N. Y.
Project: 133-mile, 6-in. line from Mt. Pleasant to Dallas-Ft. Worth area.
Status: Planned.

CARL M. LOEB, RHOADES & CO., 42 Wall St., New York 5.
Project: 75-mile, 20-in. from New Jersey refineries to Long Island airports, Idlewild and La Guardia.
Status: Proposed.

CHEROKEE PIPE LINE CO., Bartlesville, Okla.
Project: 12-mile jet-fuel line from main line at St. Charles, Mo., to Lambert airport, St. Louis.

CONTINENTAL PIPE LINE CO., Bartlesville, Okla.
Project: 225-mile products line, Ponca City, Okla., to Wichita Falls, Texas.
Status: Planned.

DIXIE PIPE LINE CO., 800 Enterprise Building, Tulsa.
Project: 1,077-mile, 12, 10, 8 and 6-in. LPG line from Mont Belvieu, Tex., to Cary, N. C.
Status: Under way.
Completion: Fall, 1961.
Contractors: Section 1, Houston Contracting Co.; Section 2, Sharman, Allen, Gay & Taylor; Section 3, H. B. Zachry Co.; Section 4, O. R. Burden Construction Co.; Section 5, Stanley-Bledsoe Corp.

EL PASO NATURAL GAS CO., El Paso, Tex.
Project: 58-mile, 6 in. LPG line Jal, N. M., plant to El Paso Natural Gas Products Co. refinery, Odessa, Tex.
Status: Planned.

GREAT LAKES PIPE LINE CO., Kansas City, Mo.
Project: Conversion of 6-in. products lines from Des Moines, Iowa, to Minneapolis and to Chicago area to tie-in with Northern Gas Products LPG line from Bushton, Kans.
Status: Planned.

HUMBLE PIPE LINE CO., Box 2220, Houston, Tex.
★ Project: 270-mile line west from Baytown, 177 miles 8 and 10-in. with 6-in. branches 43 miles to Austin and 50 miles to San Antonio.
Status: Under way.
Completion: Early 1962.

INTERSTATE OIL PIPE LINE CO., Box 1107, Shreveport, La.
Project: 11-mile, 6-in., Baton Rouge, La., to Dixie Pipe Line near Baker, La.
Status: Planned.
Completion: Nov. 30, 1961.

MID-AMERICA PIPELINE CO., 1437 S. Boulder, Tulsa.
Project: 106-mile, 6⅝-in. extension from Whiting to Ogden, Iowa.
Status: Under way.
Contractor: Bristow-Hyde Construction Co.
Completion Oct. 15, 1961.
Project: 100-mile extension from Ogden to Charles City, Iowa.,
Status: Planned.
Construction: 1962.

NORTHERN GAS PRODUCTS CO., Omaha, Neb.
Project: 350-mile, 8-in. LPG line from Bushton, Kans., plant to Des Moines, Iowa, connecting with Great Lakes 6-in. lines to Twin Cities and to Chicago area.
Status: Planned.

OLYMPIC PIPELINE CO. (proposed)
Project: 94 miles, 16-in.; 162 miles, 11-in., 45 miles, 8-in. and 23 miles, 6-in. from Ferndale and Anacortes, Wash., refineries to Seattle and Portland.
Status: Planned.

POTOMAC PUBLIC SERVICE CO., Arlington. Va.
Project: 80-mile, Baltimore to Washington airports.
Status: Planned.

SINCLAIR PIPE LINE CO., Independence, Kans.
Project: 3-mile, 8-in. line to Patterson terminal, Paulsboro, N. J., to existing line.
Status: Planned.

SUNOLIN CHEMICAL CO., 1608 Walnut St., Philadelphia, Pa.
Project: 80-mile, 4 and 6-in. products and chemicals line, Deepwater to Paulsboro, N. J.
Completion: Oct. 1, 1961.
Contractor: Sheehan Pipe Line Construction Co.

The Products Pipe Lines map in this issue shows the location of Underground LPG storage areas.

35 OF THE 38

mined storage caverns were engineered and constructed by

FENIX & SCISSON
INC.
ENGINEERS • CONTRACTORS
5805 E. 15TH • TULSA 12, OKLAHOMA
WILMINGTON TRUST BLDG., WILMINGTON, DEL.

PIPELINE CONSTRUCTION

TEXAS EASTMAN CO., Longview, Texas.
★ Project: 275 miles, 6-in. LPG line from Sweeney to Longview, Texas.
Status: Underway.
Completion: December, 1961.
Contractor: O. R. Burden Construction Co.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Project: 6-mile, 8-in., Deer Park to Pasadena, Texas.
Status: Planned.

WEST SHORE PIPE LINE CO., 1033 First Ave., Des Plaines, Ill.
Project: 285-mile, 10-16-in. line from East Chicago, Ind., to Green Bay, Wis.
Status: Under way.
Completion: Mid-September 1961.
Contractors: Section One, 10 miles in Lake County, Indiana, Midwestern Contractors, Inc.; Section Two, 36 miles in Cook and Will counties, Illinois, and Section Three, 33 miles in Cook and Du Page counties, Illinois, Contracting and Materials Co.; Section Four, 63 miles in Cook and Lake counties, Illinois, and Kenosha, Racine and Milwaukee counties, Wisconsin, Houston Contracting Co.; Section Five, 43.5 miles in Milwaukee and Waukesha counties, Wisconsin, and Section Seven, 29 miles in Brown County, Wisconsin, Sommerville Construction Co., and Section Six, 76 miles in Milwaukee, Washington, Sheboygan, Calumet and Manitowoc counties, Wisconsin, Panama-Williams Corp.

YELLOWSTONE PIPE LINE CO., Ponca City, Okla.
Project: 82-mile, 6-in. products line from Helena to Great Falls, Mont.
Completion: Dec. 1, 1961.
Contractor: R. H. Fulton & Co.

U. S. Natural Gas Pipelines

ALABAMA-TENNESSEE NATURAL GAS CO., Box 380, Florence, Ala.
Project: 3½-mile, 6-in. line to serve Armour Agricultural Chemical in Colbert County, Alabama.
Status: Planned.

ALAMO GAS SUPPLY CO., Alamo National Building, San Antonio, Tex.
Project: 166 miles of 20, 22, and 24-in. line and 101 miles of 12, 16, and 24-in. line from Texas Gulf Coast to San Antonio.

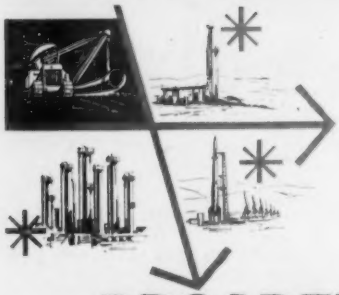
ALASKA PIPE LINE CO., Houston, Tex.
Project: 74 miles, Kenai to Anchorage.
Status: Construction resumed.
Project: Extension of Kenai-Anchorage line to Fairbanks.
Status: Feasibility studies ordered.

ALGONQUIN GAS TRANSMISSION CO., 25 Faneuil Hall Square, Boston 9, Mass.
Project: 5.6 miles, 8-in. near Plymouth, Mass.
Status: Temporary FPC approval.

AMERICAN LOUISIANA PIPE LINE CO., Detroit, Mich.
Project: 25-mile, 8-in. to connect Holly Ridge field, Tensas Parish, Louisiana, to main line.
Status: Pending FPC approval.

ANADARKO PRODUCING CO., (Panhandle Eastern subsidiary), Box 1348, Kansas City 41, Mo.
Project: 83-mile, 10-12-in., from Spivey-Grabs-Basil field to Skelly Oil Refinery, El Dorado, Kans.
Contractor: R. H. Fulton & Co.

ARKANSAS WESTERN GAS CO., Box 405, Fayetteville, Ark.
Project: New lines from Altus, Coal Hill.



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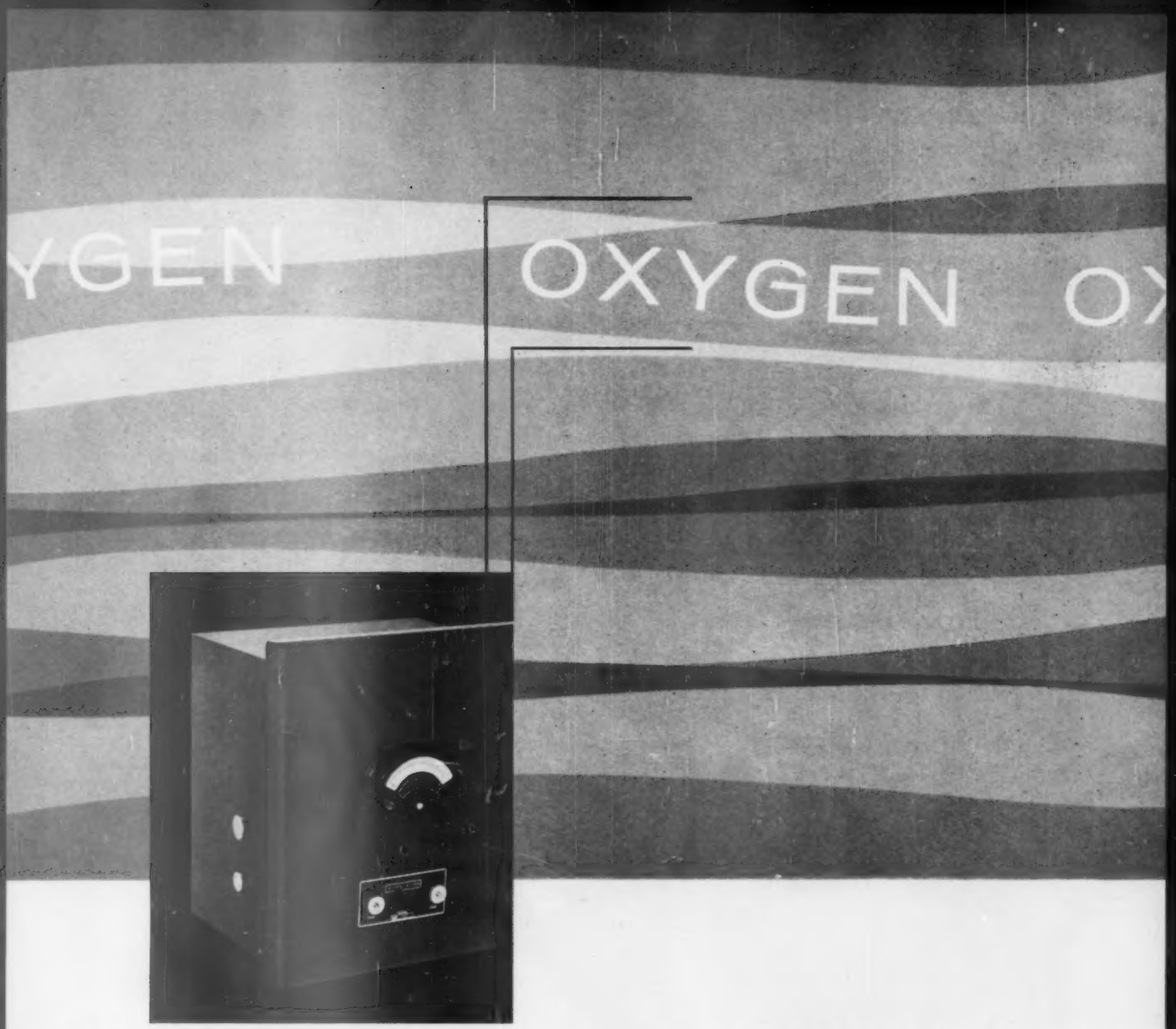

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MODEL F-3 operates on a paramagnetic principle found only in Beckman* Oxygen Analyzers. Assures fast response, great sensitivity, and simple operation. And the F-3 has dual ranges that are directly linear. Read oxygen concentration from a self-contained meter or a standard potentiometric recorder. The Model F-3 is ideal for wide ranges of analyses–from 0-1% to 0-100%–and suppressed ranges are available, too.

MODEL G-2 also utilizes the paramagnetic principle of operation. Supplied with potentiometric recorder modified to provide automatic instrument zeroing for critical analyses. The Model G-2 is ideal for narrow and highly suppressed ranges–0-1000 ppm to 99-100%.

MODEL 80 TRACE OXYGEN ANALYZER operates on the electrolytic cell principle. This dual range instrument provides highly accurate linear measurement in the parts per million ranges. The Model 80 is particularly suited for monitoring gases in which oxygen content must be extremely low–from 0-5 to 0-500 ppm.

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Beckman INSTRUMENTS, INC.

SCIENTIFIC AND PROCESS INSTRUMENTS DIVISION

Fullerton, California

PIPELINE CONSTRUCTION

and Rock Creek fields to the main system.
Status: Approved by Arkansas PSC.
★ Project: 10 miles, 12-in. Brashears to Cannon Creek, Ark.
Status: Underway.
Completion: Oct. 1.
Contractor: Worth James.

BI-STONE FUEL CO., Corsicana, Tex.
★ Project: 100-mile, 16-in. main line from Bethel field, Anderson County, to Merit, Hunt County, North Texas, with 75 miles, 10, 8 and 6-in. laterals.
Status: Planned.

BORDER GAS TRANSMISSION CORP. (Lehman Brothers, New York, and Rio Gas Gathering Co., 615 National Bank of Commerce Building, San Antonio 5, Tex.).
Project: Gathering lines in Starr, Zapata, Jim Hogg, Brooks, and Webb counties, Texas.
Status: Proposed.
Project: Gathering lines in Dimmit, Zavala, and La Salle counties, Texas.
Statusá Proposed.

CAROLINA PIPELINE CO., 4445 Devine St., Columbia, S. C.
Project: 67-mile, 8⅝-in., 20-mile, 10¾-in., Aiken to Camden, S. C.
Completion: Oct. 1, 1961.
Contractor: Panama-Williams Corp.

CITIES SERVICE GAS CO., Box 1995, Oklahoma City 1, Okla.
Project: 10½ miles of 8-in. to connect Rounds and Porter plant with main line in Marion County, Kansas.
Status: Planned.
Project: Gathering lines in Sterling field, Comanche County, Oklahoma.
Status: Pending FPC approval.

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Export Office: D. T. O'Connor, Inc., 500 Fifth Avenue, New York 36, N. Y., BRyant 9-2216
In Canada: Canadian Equipment Sales & Service Co., Ltd., 7310 99th St., Edmonton, Alberta, Canada

COASTAL TRANSMISSION CO., Houston, Tex.
Project: 71 miles laterals in Florida.
Status: Approved by FPC examiner.

COLORADO GAS TRANSMISSION CO., Colorado Springs, Colo.
Project: 250-mile, 20-in. line, from Ignacio-Blanco area, Southwest Colorado, to Walsenburg, Pueblo and Colorado Springs, Colo.
Status: Application before Colorado PUC.

COLORADO INTERSTATE GAS CO., Box 1087, Colorado Springs, Colo.
Project: 7 miles of 20-in. in Texas Panhandle.
Status: Pending FPC approval.
Completion: 1961.
Project: 109 miles of 26-in. from Texas Panhandle to southeastern Colorado; 134 miles of 34-in. from there to Pueblo, and 107 miles of 30-in. on to Denver.
Status: Pending FPC approval.
Project: 155 miles of 34-in. from Rock Springs, Wyo., to Provo, Utah, to connect with El Paso's proposed 395-mile line to California.
Status: Approved by FPC.
Completion: 1963.
Project: 32 miles of 6-in. from Central Colorado to Trinidad.
Status: Pending FPC approval.

COLORADO OIL & GAS CORP., Denver, Colo.
Project: 402-mile line from Gubik field to Fairbanks, Alaska.
Status: Proposed.

COLORADO-WYOMING GAS CO., Box 480, Denver 1, Colo.
Project: 4-mile, 3-in. lateral to Erie, Colo.
Status: Pending FPC approval.
Project: 2-mile, 4-in. lateral to Niwot, Colo.
Status: Pending FPC approval.
Project: 16.7-mile, 16-in. from Arsenal Junction to Louisville, Colo.
Completion: Oct. 15.
Contractor: Colorado-Wyoming Construction Co.

COLUMBIA GAS SYSTEM, INC., 120 East 41 St., New York 17.
Projects: Eight loops totaling 96.9 miles, 30-in. in Kentucky, Tennessee, Mississippi and Louisiana, plus 29 miles of 12-in. gathering line from near Houma, La., to the Texaco Dog Lake field.
Status: Planned.
Completion: 1961.

COLUMBIA GULF TRANSMISSION CO., Box 683, Houston 1, Tex.
Project: 9½ miles, 10-in. gathering line, Marguerite to Ivanhoe, La.
Status: Under way.
Project: 0.9 mile, 6-in. gathering line in Terrebonne Parish, Louisiana.
Status: Under way.
Project: 97 miles of main-line loop in Kentucky, Tennessee, Mississippi, and Louisiana, and 29 miles of 12-in. lateral supply lines in Louisiana.
Status: Pending FPC approval.
Completion: 1961.

EAST TENNESSEE NATURAL GAS CO., Knoxville, Tenn.
Project: 10.1 miles, 4-in. lateral to South Carthage, Tenn., and 13.4 miles, 6-in. lateral to Pleasant Hill, Tenn.
Status: Planned.

EL PASO GAS SUPPLY CO., (subsidiary of El Paso Natural Gas Co., Box 1492, El Paso).
Project: 228-mile, 30-in. line, Live Oak County to Sonora, Sutton County.
Status: Pending FPC approval.

EL PASO NATURAL GAS CO., Box 1492, El Paso, Tex.
Project: 61.3-mile, 10¾-in. lateral to Bremerton, Wash., to be extended 75 miles to Port Angeles by Natural Gas

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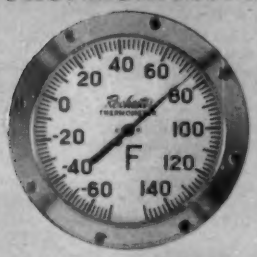

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CONTROLS DIVISION

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PIPELINE CONSTRUCTION

Transmission Co., El Paso subsidiary.
Status: Before FPC.
Project: 8.2-mile, 34-in. loop on Gallup discharge.
Status: Pending FPC approval.
Project: 14.2-mile, 6⅝-in., South Sawyer to Sinclair plant 29.
Status: Pending FPC approval.
Project: 17 mile, 8⅝-in. from Pacific Gas Transmission 36-in. line to Klamath Falls, Ore.
Status: Pending FPC approval.
Project: 37.4 miles, 8⅝-in., San Juan Main line to Snowflake meter station.
Status: Approved.
Completion: December 1961.
Project: 17-mile, 30-in. loop on Coeur d'Alene lateral.
Status: Approved.
Completion: Oct. 1, 1961.

EQUITABLE GAS CO., 420 Boulevard of the Allies, Pittsburgh, Pa.
Project: 17 miles of 20-in. in Greene and Washington counties, Pennsylvania.
Status: Approved by FPC.
Completion: October 1962.

GRAND VALLEY TRANSMISSION CO., Green River, Utah.
Project: 16-mile line from Westover field, Grand County, to El Paso Natural Gas Co. main line.
Status: Approved by FPC.

HOUSTON TEXAS GAS & OIL CORP., Box 10400, St. Petersburg 33, Fla.
Project: 16.9 miles, 4½-in., mainline to Homestead, Fla.
Status: Temporarily certified.
Completion: Nov. 1, 1961.
Contractor: Constructors of Florida.
Project: 174.2 miles, 2⅜-in. to 6⅝-in. distribution lines in Florida.
Status: Pending approval.

HUMBLE OIL & REFINING CO., Houston, Texas.
Project: 13.5-mile, 26-in. line from Port Acres to Bridge City, Texas.

IROQUOIS GAS CORP., Buffalo, N. Y.
Project: 21.5 miles of line, 2 miles, 16-in.; 5.5 miles, 12-in.; 14 miles, small diameter, to serve Perrysburg storage.
Status: Before FPC.

KANSAS-NEBRASKA NATURAL GAS CO., INC., Hastings, Neb.
Project: 6.3-mile, 8-in. gas line to serve coop fertilizer plant at Hastings, Neb.
Completion: Sept. 1, 1961.
Project: 24.5 miles, 8-in. gas line from Huntsman to Northport, Neb.
Completion: Oct. 1, 1961.

LO-VACA GATHERING CO. (see parent company, Coastal States Gas Producing Co.).

MANUFACTURERS LIGHT & HEAT CO., Union Trust Building, Pittsburgh 19, Pa.
Project: 10½ miles of 24-in. Washington and Beaver counties, Pennsylvania.
Status: Planned.
Completion: September 1961.
Project: 20-mile, 20-in., Glenville, W. Va., to New Milton District.
Status: Pending FPC approval.
Completion: December 1, 1961.

MICHIGAN WISCONSIN PIPE LINE CO., 500 Griswold St., Detroit, Mich.
Project: 64.5 miles, 4/10-in. Laverne field gathering lines.
Status: Planned.
Completion: Gradually over 1961.
Project: 97 miles, 16/20-in. gas line from Woodward, Okla., area to Greensburg, Kans., compressor station.
Status: Approved by FPC.
Project: 68 miles, 4/10-in. gathering system, Woodward, Okla., area.
Status: Approved by FPC.
Project: 26 miles, 30-in. loop in Michigan, 10 miles, 12-in. loop in Wisconsin.
Status: Pending FPC approval.
Project: 30 miles, 30-in. from Station 10 to Woolfolk station, Wisconsin.
Status: Approved by FPC.

MISSISSIPPI RIVER FUEL CORP., 407 North 8th Street, St. Louis 1, Mo.
Project: 5 miles of 16-in. and 15 miles of 12-in. from Collinsville, Ill., to St. Jacob, Ill.
Status: Pending FPC approval.

MONTANA-DAKOTA UTILITIES CO., Minneapolis, Minn.
Project: 106-mile, 12-in.; 22-mile, 3-in.; 20-mile, 2-in., Minot to Bismarck, N. D.
Status: Pending FPC approval.
Project: 12-mile, 6-in.; 17-mile, 4-in.; 2-mile, 2-in., Alexander to Watford City, N. D.
Status: Pending FPC approval.
Project: 14-mile, 8-in., McGregor to Tioga, N. D.
Status: Pending FPC approval.
Project: 3-mile, 3-in., lateral to Fryburg, N. D.
Status: Pending FPC approval.
Project: 2-mile, 4-in., lateral to Holly Sugar Corp., Hardin, Mont.
Status: Pending FPC approval.

MONTANA POWER CO., Box 1338, Butte, Mont.
Project: 16-in. line from Carway, Alta., to Cut Bank, Mont.
Contractor: Majestic Contractors, Inc.
Completion: 1961.

MOUNTAIN FUEL SUPPLY CO., Salt Lake City, Utah.

MOUNTAIN FUEL SUPPLY CO.
Project: 104-mile, 20-in. line from Ouray to Clear Creek, Utah.

The successful completion of a Sheehan job — on time and on cost — is the result of careful planning and efficient operation by veterans in the construction of intermediary and connecting lines as well as the longer transmission lines . . . regardless of varying requirements for different jobs.

Sheehan "spreads" assure satisfaction simply through the use of the most modern and efficient methods, and through close attention to detail . . . every mile of the way.

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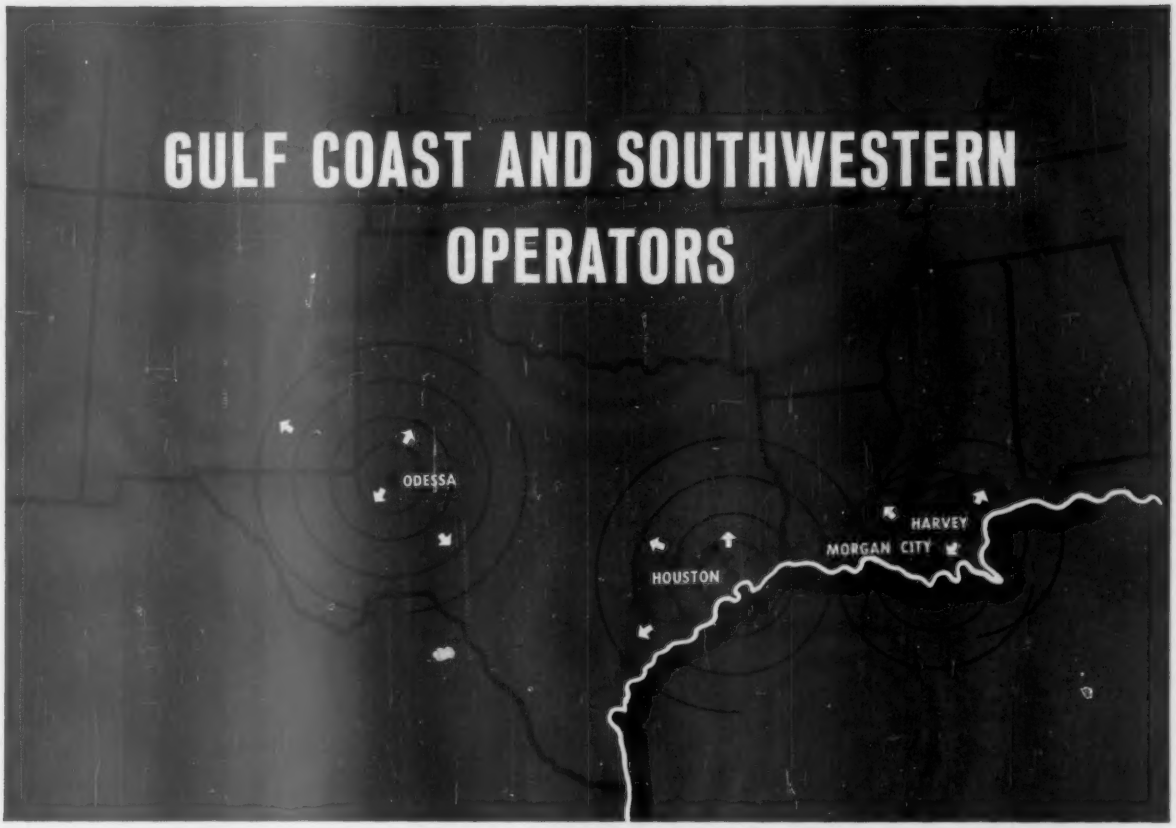

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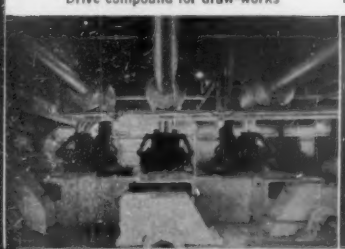
Drive compound for draw-works



Tool pusher's office with drilling control indicators

Crew's lounge

Helicopter flight deck

PIPELINE CONSTRUCTION

Completion: Oct. 15, 1961.
Contractor: Pease Brothers, Inc.

NATURAL GAS PIPELINE CO. OF AMERICA, 122 South Michigan Avenue, Chicago.
Project: 62-miles, 30-in., Marshall to Spring, Tex.
Completion: Oct. 15, 1961.
Contractor: Panama-Williams Corp.
Project: 72 miles, 30-in., Hungerford to Refugio, Tex.
Completion: Oct. 15, 1961.
Contractor: Panama-Williams Corp.
★ Project: Two 30-in. loops, 38 miles between Gum Spring and Nydis and 40 miles from Rowhatan to Missouri border.
Status: Under way.
Contractor: Williams Brothers Co.

NORTHERN NATURAL GAS CO., 2223 Dodge St., Omaha 1, Neb.
★ Project: 84.5 miles, 20-in., Menominee, Ill., to Janesville, Wis.
Status: Approved.
Completion: Oct. 15, 1961.
Contractor: R. H. Fulton.
★ Project: 124.3 miles, 26-in. loop lines east of Ogden and Waterloo, Iowa.
Status: Approved.
Completion: Oct. 15, 1961.
Contractor: R. H. Fulton.

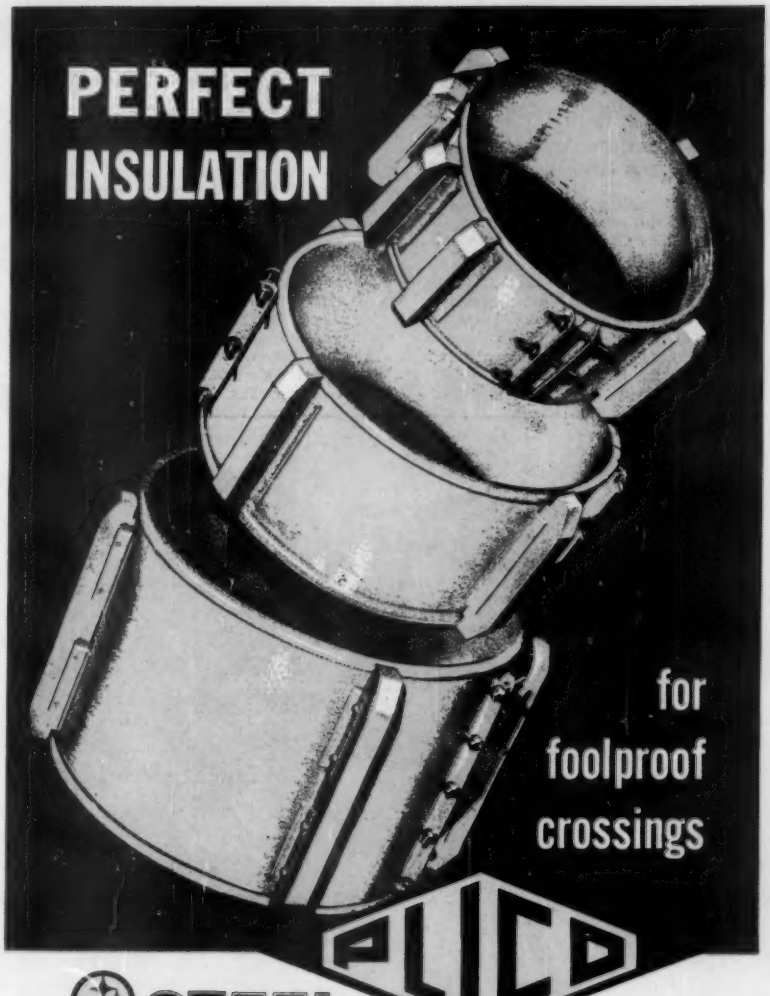
OHIO FUEL GAS CO., 90 N. Front St., Columbus, Ohio.
★ Project: Replace 8.4 miles, 12¾-in., Wayne, Stark counties, Ohio.
Completion: Oct. 1, 1961.
Contractor: Central Pipe Line Co.
★ Project: Replace 5.7 miles, 20-in., Medina, Lorain counties, Ohio.
Completion: Oct. 1, 1961.
Contractor: Shamrock Construction Co.

OKALOOSA COUNTY GAS DISTRICT, Box 548, Valparaiso, Fla.
Project: 33-mile, 10-in., Milton to Ft. Walton, Fla.
Completion: Nov. 1, 1961.
Contractor: E. L. Walker, Pensacola, Fla.

OKLAHOMA-ILLINOIS GAS PIPELINE CO., M. & M. Bldg., Houston 1, Texas. (Joint Fish Engineering Corp. and Pan American Petroleum Corp. venture.)
Project: 550-mile, large diameter line from Woodward, Okla., to St. Louis, Mo.
Status: Proposed.

PACIFIC GAS & ELECTRIC CO., 245 Market St., San Francisco, Calif.
Project: 67 miles of line from Kettleman Hills to Morro Bay, Calif.
Project: 120 miles of 34-in. looping of Topock-Milpitas main line.
Status: Planned. Pending FPC approval.
Completion: 1963.
Project: 291 miles of 36-in. from the California-Oregon border to Antioch, Calif. (Part of a 1,400-mile project to move Alberta gas to San Francisco.)
Contractor: H. C. Price Co., Bartlesville, Okla. (Bechtel Corp. San Francisco, is the engineering manager.)
Status: Under way.
Completion: Dec. 1961.

PACIFIC GAS TRANSMISSION Co., (Pacific Gas & Electric Co., San Francisco).
Project: 611 miles of 36-in. from the Canadian border at Eastport, Idaho, to the California border near Klammath Falls, Ore. (Part of a 1,400-mile project to move Alberta gas to San Francisco.)
Contractors: Western Pipe Line, Inc., Austin, Tex., and J. P. Neill & Co., Dallas, have contracts for the 465-mile southern portion. H. C. Price Co., Bartlesville, Okla., has contract for the 146-mile northern portion from Rosalia, Wash.,



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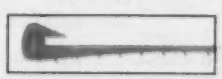
the strongest, safest insulating spacers ever produced!

RUGGED HEAVY DUTY STEEL BODY, hot dip galvanized and enameled the distinctive PLICO Yellow. Defies corrosion and abuse. Complete lines in 6, 8 or 12-in. body widths.

VIRGIN POLYETHYLENE LINER—no fillers—no "regenerated" scrap—beefed up in entire edge area to eliminate cuts or short-outs even if a spacer should cock as it is slid into the casing. Assures positive, permanent insulation.



FLINT-HARD MICARTA SKIDS shrug off abrasion and heaviest loads. Outstanding dielectric and mechanical qualities give unusual margin of safety.

Everything about PLICO **STEEL** Spacers—including hot dip galvanized fastenings—is top quality . . . yet they cost no more than so-called "economy" spacers. Why compromise? Why send a boy to do a man's job? CALL YOUR NEAREST PLICO DISTRIBUTOR OR WRITE US FOR FULL DATA AND PRICES.

PLICO
MARWAIS MANUFACTURING DIVISION
A DIVISION OF MARWAIS STEEL CO.
6466 Gayhart Street • Los Angeles 22 • California
RAymond 3-8831

PIPELINE CONSTRUCTION

to Eastport, Idaho. (Bechtel Corp., San Francisco, is the engineering manager.)
Status: Under way.
Completion: Dec. 1961.

PACIFIC LIGHTING GAS SUPPLY CO., 720 W. Eighth Street, Los Angeles 17, Calif.
★ Project: 24 miles, 16-in., Gaviota to Goleta, Calif.
Status: Pending California PUC approval.
Completion: Spring, 1962.

PANHANDLE EASTERN PIPE LINE CO., 120 Broadway, New York.
Project: 298 miles of 30-in. loops, 43 miles of 16 to 26-in. supply laterals, and 80 miles of 6 to 12-in. sales laterals.
Status: Pending FPC approval.
Project: 150 miles, 24-in., 50 miles, 22-in. from Elk City, Okla., field to main line.
Status: Approved by FPC.

PHILLIPS PETROLEUM CO., Bartlesville, Okla.
Project: 16 miles of 2 to 8-in. gathering line in Eddy County, New Mexico.
Status: Planned.
Project: 17 miles of 4 to 10-in. gathering line in Midland County, Texas.
Status: Planned.

PIONEER NATURAL GAS CO., Amarillo, Tex.
Project: 21 miles of 12-in. from Sudan to Muleshoe, Tex.
Status: Pending FPC approval.
Project: 12 miles of 10-in. from Muleshoe, Tex., northward.
Status: Pending FPC approval.

PIPELINE TECHNOLOGISTS, INC., Houston, Tex.
Project: 50 miles various size lines, gas gathering system, Marion County, Kansas.
Completion: September 1961.

SOUTH GEORGIA NATURAL GAS CO., Box 791, Thomasville, Ga.
Project: 2½-mile, 3½-in. from main line to Sylvester, Ga.
Completion: November 1961.
Project: 2½-mile, 3½-in. from main line to Ocilla, Ga.
Completion: November 1961.

SOUTHERN CALIFORNIA GAS CO., and SOUTHERN COUNTIES GAS CO. OF CALIFORNIA, Los Angeles, Calif.
Project: 92.9-mile, 34-in., Ivanpah to Newberry, Calif.
Status: Approved by California PUC.
Completion: Jan. 1, 1964.

SOUTHERN NATURAL GAS CO., Birmingham, Ala.
Project: 14.4 miles, 20-in. gas line from Gwinville field to Pickens station.
Status: Pending FPC approval.
Completion: Dec. 31, 1961.

SOUTHERN UNION GAS CO., Fidelity Union Tower, Dallis 1, and **EL PASO NATURAL GAS CO.,** Box 1492, El Paso, Tex.
Project: 60-mile line from El Paso's main line near Holbrook, Ariz., to paper mill under construction near Snowflake.
Status: Planned.

ST. LAWRENCE GAS CO., Ogdensburg, N. Y.
Project: 75 miles of line near Cornwall, Ont., to Ogdensburg, N. Y.
Status: Approved by FPC.

TENNESSEE-CALIFORNIA GAS TRANSMISSION CO., Box 2511, Houston, Tex.
Project: 105-mile, 26-in. line from Humble's King Ranch via Kleberg, Brooks and Hidalgo counties to Mexican border to connect with Tennessee-Pemex line to California. Included are 69 miles of 12-in. and smaller laterals.
Status: Pending FPC decision.

TENNESSEE GAS PIPELINE CO., a division of Tennessee Gas Transmission Co., Box 2511, Houston 1, Tex.
Project: 7.4 miles, 12-in. gathering line, offshore Louisiana.
Status: Under construction.
Contractors: Sam Carline, Inc., laying contractor; Brown & Root, Inc., burying contractor.
Project: 18.5 miles, 12-in. gathering line, offshore Louisiana.
Status: Under construction.
Contractor: Brown & Root, Inc.
Project: 12.6 miles, 12-in. gathering line, offshore Louisiana.
Status: Under construction.
Contractor: Brown & Root, Inc.
Project: 20.6 miles, 12-in. gathering line, offshore Louisiana.
Status: Pending FPC approval.
Project: 13 miles, 20-in. gathering line, offshore Louisiana.
Status: Under construction.
Contractor: J. Ray McDermott, Inc.
Project: 6 miles, 12-in. gathering line, offshore Louisiana.
Status: Approved by FPC.

TENNESSEE GAS TRANSMISSION CO., Box 2511, Houston, Tex.
Project: 1,100-mile, 30-in. line Texas to California via Mexico (see Foreign).
Project: 292-mile line from the California-Mexican border to Los Angeles to tie in with above-mentioned line.
Status: Tennessee Gas' subsidiary, California Gas Transmission Co., and Southern California Edison Co. have applied to California PUC. Also pending FPC approval.
Project: A line from King Ranch, Texas, to the Mexican border, to connect with

TOGETHER FOR GOOD

Reilly Coal Tar Enamels and related primers, used together, provide the corrosion protection needed by underground metal structures. The Reilly hot enamel system is:

electrically insulated	oxidationproof
waterproof	stressproof
oilproof	tough and strong
bacteriaproof	permanently bonded

In addition, Reilly coating systems offer ultimate longevity because they inherit the chemical inertness and stability of coal tar, from which they are made.

Specify Reilly hot-applied coal tar enamels and related primers for oil, gas and water pipelines.

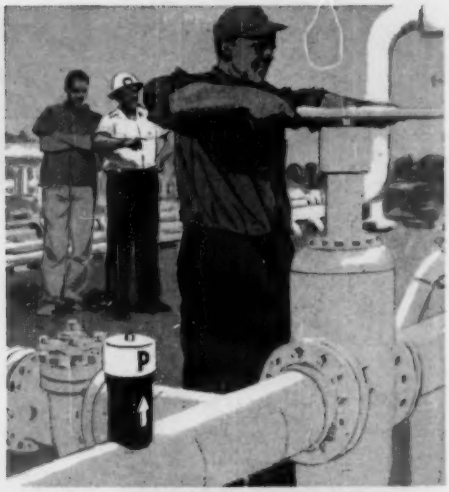
REILLY ENAMEL AND PRIMER

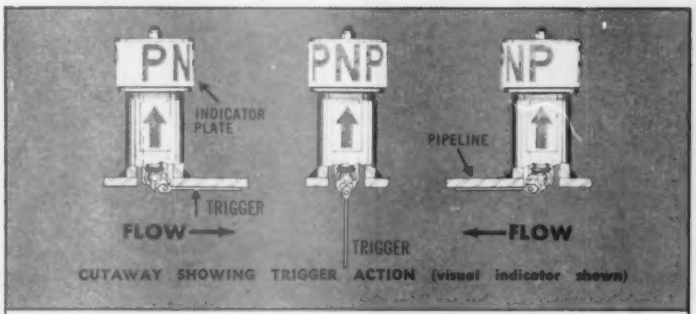
Reilly Pipeline Enamel, Reilly Intermediate Enamel, Reilly 230-A Enamel, Reilly 230 AWWA Enamel	Reilly Pipeline Primer, Reilly QD Primer, Reilly 230 X-10 Primer, Reilly 230 X-10 Primer	Reilly Redhead ® Primer
Reilly Hot Service Enamel	Reilly 230 X-10 Primer	

REILLY TAR & CHEMICAL CORP.
1615 MERCHANTS BANK BUILDING, INDIANAPOLIS 4, INDIANA

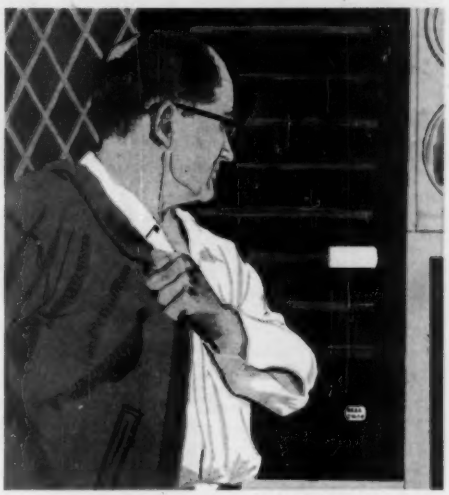
NEWS FROM DOWN THE LINE!

Successful PIG-SIG II
now has NEW BI-DIRECTIONAL TRIGGER
Plus Other Optional Features





• The WmSon PIG-SIG II Scraper Passage Indicator which has earned such wide acceptance in the pipeline industry is now available with bi-directional trigger as an optional feature. The trigger is designed for use in lines where scraper travel may be in either direction and in meter proving loops. Other optional features: pneumatic control with automatic reset and automatic counter to record scraper passage.



PIG-SIG II PATENT PENDING

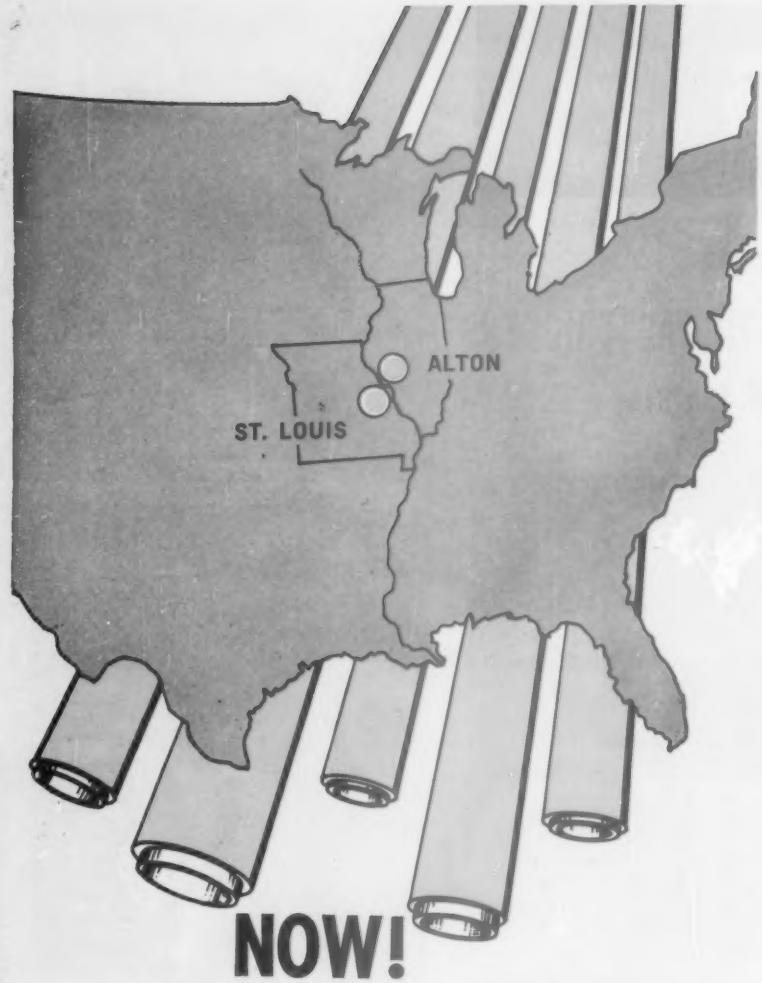
Long trigger action detects scrapers even in oversize pipe

In the top example, PIG-SIG II with visual indicator shows the station operator the pig has arrived. He doesn't need to wait and listen at the scraper trap. The next example shows how PIG-SIG II with electric indicator can signal arrival of pig to pump station operator. It can start operation of automatic equipment to open and close valves. PIG-SIG II is easily installed under pressure with WmSon-Hillco Tapping Machines. It is available with visual indicator and manual reset; electrical or pneumatic signal with automatic reset; extended or regular.

FOR ADDITIONAL INFORMATION WRITE DEPT. A FOR BULLETIN A-199-A

T.D. Williamson, Inc.
P. O. BOX 40 • TULSA 2, OKLAHOMA
REPRESENTATIVES AROUND THE WORLD

PIG-SIG II can be used to actuate pneumatic and electric control systems. WmSon engineers may be able to offer dollar saving tips on its use in such systems. **Contact your representative or the Tulsa office.**



NOW!

from SPI's new Alton, Illinois Plant

comes STANDARD X-TRU-COAT

Standard Pipeprotection's new plant at Alton, Illinois has been shipping Standard X-Tru-Coat pipe to the Southwest and West since early July. Sizes available include ¾" Nom. through 4½" O.D.

X-Tru-Coat high density polyethylene plastic coating for pipe is produced under the DeKoron process — Pat. Nos. 2,447,420 and 2,467,642 — and is extruded on pipe over a pressure sensitive adhesive.

Standard Procedures assuring top quality prevail at the Alton, Illinois plant, as they have for many years at SPI's coating and wrapping plant in St. Louis. In-Transit privileges are available at both plants from any pipe mill.

Standard Pipeprotection, with the introduction of X-Tru-Coat, has continued to contribute to the progress of the oil and gas industry.

Write for complete information and for Price List Number X-1.

SP®

standard pipeprotection inc.

3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MISSOURI

PIPELINE CONSTRUCTION

proposed line through Mexico to California.
Status: Tennessee Gas subsidiary, Tennessee California Gas Transmission Co., to build and operate the Texas segment.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Projects: 165 miles of 20-in. from West Monroe, La., to Kosciusko, Miss.
Status: Underway.
Contractor: Houston Contracting Co.
Completion: 1961.
Project: 40 miles, 36-in., Station 26 to Station 27, N. J.
Status: Planned, authorized.
Contractors: H. C. Price Co., Napp-Grecco Co.
Completion: 1961.
Project: 89 miles, 30-in. Kosciusko station, Miss., and Station 21-A, Pa.
Status: Temporary FPC approval.
Completion: 1961.
Project: 40 miles, 30-in. Delmont station, Pa., to Station 26, N. J.
Status: Planned, filed with FPC.
Completion: 1961.
Project: 45 miles, 30-in. Delmont station, Pa., to Station 26, N. J.
Status: Planned, filed with FPC.
Completion: 1962.
Project: 42 miles, 30-in., Kosciusko station, Miss., to Station 21-A, Pa.
Status: Temporary FPC approval.
Completion: 1962.
Project: 57 miles, 14-in., Castor, La., to West Monroe, La.
Status: Planned, filed with FPC.
Completion: 1961.
Project: 13 miles, 14-in. Middlesex County, to Barnardsville, N. J.
Status: Planned, filed with FPC.
Completion: 1962.
Project: 14 miles, 12 in., Barnardsville to Roseland, N. J.
Status: Planned, filed with FPC.
Completion: 1961.
Project: 11 miles, 10-in., Middlesex County to Helvetta, N. J.
Status: Planned, filed with FPC.
Completion: 1961.
Project: 17.42 miles, 30-in. near Wilkesville, O. to Athens station.
Status: Underway.
Contractor: Western Pipe Line, Inc..
Project: 12 miles, 30-in., near Moundsville, W. Va., to Holbrook station, Pa.
Status: Underway.
Contractor: Western Pipe Line, Inc..

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky.
★ Project: 35 miles, 30-in. and 21 miles, 26-in. in Tennessee, Mississippi, Arkansas, Louisiana.
Status: Under way.
Contractor: Houston Contracting Co.
Project: 52 miles, 20-in., 16-in. and 8-in. from Bay Round, to Morgan City, La.
Status: Under way.
Contractor: Houston Contracting Co.

TRANSCONTINENTAL GAS PIPE LINE CORP., 3100 Travis St., Houston, Tex.
Project: 30 miles, 30-in. main-line loop, Texas.
Status: Approved.
Completion: 1961.
Contractor: Houston Contracting Co.
Project: 21 miles, 36:in. main-line loop, Mississippi.
Status: Approved.
Completion: 1961.
Contractor: C. S. Lenoir.
Project: 62 miles, 36-in. main-line loop, Alabama.
Status: Approved.
Completion: 1961.
Contractor: C. S. Lenoir.

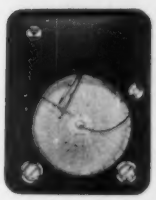
...WAYS AMERICAN® EQUIPMENT SOLVES YOUR MEASUREMENT AND CONTROL PROBLEMS

Whether your system is large or small, you can rely on American Meter's 125 years of engineering experience for the field-proven equipment you need for years of accurate, trouble-free measurement and control. Built to the highest standards of quality for sustained accuracy at lowest maintenance cost, American instrumentation reduces manpower requirements and provides continuous operating economies. Contact your nearest representative for complete details on how American equipment can build accuracy, dependability and economy into your system.

1 **ORIFICE METERS**

Dri-flo Orifice Meters in recording, indicating and integrating models assure maximum accuracy in differential pressure measurement.

2 **CONTROLLERS**



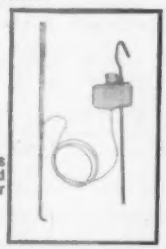
Series A-88 Controllers accurately control continuous process variables.

3 **GASCLOK POWER DRIVE**

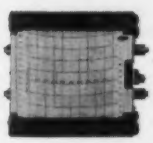
The ideal air or gas-operated instrument power drive and timing unit for remote installations.

4 **CANNON METER PENS**

Controlled-flow meter pens prevent chart smearing and blurring. Record up to a year without refilling.



5 **STRIP CHART RECORDER**



Provides a long, unattended record with high resolution for accurate interpretation.

6 **TELEMETERING SYSTEMS**

Tone-frequency and multiplexed Telemetering Systems meet the individual requirements of any system.

GENERAL SALES OFFICE: Philadelphia 16, Penna. • Albany • Atlanta • Baltimore Birmingham • Boston • Chicago • Dallas • Denver • Houston • Kansas City Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco Seattle • Tulsa • Wynnewood

IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Montreal • Regina • Vancouver

AMERICAN METER COMPANY

PIPELINE CONSTRUCTION

Project: 39 miles, 36-in. main-line loop, Georgia.
Status: Approved.
Completion: 1961.
Contractor: Williams Brothers Co.
Project: 22 miles, 36-in. main-line loop, South Carolina.
Status: Approved.
Completion: 1961.
Contractor: Williams Brothers Co.
Project: 15 miles, 36-in. main-line loop, North Carolina.
Status: Approved.
Completion: 1961.
Contractor: Williams Brothers Co.
Project: 7 miles, 16-in. main-line loop, New Jersey.
Status: Approved.
Completion: 1961.
Contractor: Conduit & Foundation Construction Corp.
Project: 12-in. Delaware River Crossing.
Status: Approved.
Completion: 1961.
Contractor: American Dredging Co.
Project: 6 miles, 36-in. main-line loop, Louisiana.
Status: Ttemporary authorization.
Completion: 1961.
Project: 44 miles, 36-in. main-line loop, Mississippi.
Status: Temporary authorization.
Completion: 1961.
Project: 22 miles, 36-in. main-line loop, Alabama.
Status: Temporary authorization.
Completion: 1961.
Project: 32 miles, 36-in. main-line loop, Georgia.
Status: Temporary authorization.
Completion: 1961.
Project: 21 miles, 36-in. main-line loop, South Carolina.
Status: Temporary authorization.
Completion: 1961.
Project: 14 miles, 36-in. main-line loop, North Carolina.
Status: Temporary authorization.
Completion: 1961.
Project: 22 miles, 36-in. main-line loop, Virginia.
Status: Temporary authorization.
Completion: 1961.
Project: 26 miles, 36-in. main-line loop, Maryland.
Status: Temporary authorization.
Completion: 1961.
Project: 153 miles, 3, 8, and 20-in. purchase laterals, offshore Louisiana.
Status: Temporary authorization.
Completion: 1961.
Contractor: Brown & Root.

TRANSWESTERN PIPELINE CO., 618 First City National Bank Building, Houston 2, Tex.
Project: Gathering system in West Texas and Oklahoma, approximately 100 miles, 4 to 6 in.
Status: Under way.
Contractor: Sheehan Pipe Line Construction Co.

TRUNKLINE GAS CO., Box 1642, Houston, Tex.
Project: 51.8 miles, 20-in., Kaplan to Foster, La.
Status: Under way.
Completion: November 1961.
Contractors: Grayco Constructors, Sam Carline, Inc.
Project: 78.2 miles, 26-in., Longville to Kaplan, La.
Status: Under way.
Completion: October 1961.
Contractors: Panama, Inc.; Sharman, Allen, Gay & Taylor.
Project: 21.4 miles, 18-in., 5.5 miles, 16-in., Kaplan to offshore, Vermilion Parish, La.
Status: Under way.
Completion: October 1961.
Project: 9.6 miles, 30-in., Longville to Bundick, La.
Status: Pending FPC approval.
Project: 17.5 miles, 30-in., Rayville to Pioneer, La.
Status: Pending FPC approval.
Project: 22.1 miles, 30-in., Senatobia to Byhalia, Miss.
Status: Pending FPC approval.
Project: 21.6 miles, 30-in., Hinkleville, Ky., to Vienna, Ill.
Status: Pending FPC approval.
Project: 25.2 miles, 30-in., Neoga to Bourbon, Ill.
Status: Pending FPC approval.
Project: 27 miles, 10-in., Merryville to Longville, La.
Status: Pending FPC approval.
Contractor: Glaser Construction Co.
★ Project: 35-mile, 26-in. line, Cow Island to Jennings, La.
Status: Under way.
Contractor: Sharman, Allem, Gay & Taylor Inc.

UNITED GAS PIPE LINE CO., Box 1407, Shreveport 92, La.
Project: 217 miles of 30-in. from St. Mary Parish to near Monroe, La.
Status: Under way.
Contractors: Panama, Inc.;Stanley-Bledsoe, Inc.
Completion: Late 1961.
Project: 59 miles of 36-in. purchase lateral connecting Bastian Bay field, Louisiana.
Status: Under way.
Contractor: Panama, Inc.

Pipe Line Technologists, Inc. provides specialized professional engineering for every phase of oil, gas, chemical and products pipe line operation, from the initial market analysis and feasibility reports to the design, engineering, financial planning, supervision of construction and management of the completed project. The findings of these experienced, qualified, specialists in their field are coordinated by group action into conclusive reports and efficiently built and operated pipe lines.
The experienced personnel of Pipe Line Technologists can become or augment your own pipe line engineering and management staff.

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keep you moving . . .
pre-lubed track rollers
save servicing time

Here's a *true* pipeline rig, designed and built to get you to and through any trenching job. Tractor-type crawlers provide extra clearance for travel over rocks, stumps, and most other obstructions. Shoes have deep grousers for sure traction in soft ground and in climbing steep grades. Exclusive automatic-traction brakes provide trigger-fast braking in either direction of travel . . . hold machine "fast", even on inclines.

The Unit 1220 PIPELINER keeps going, too, without excessive downtime. Track rollers are lubed and sealed at the factory . . . keep running for 1000 hours without requiring added greasing. Sealed track roller bearings keep dirt and sand out . . . reduce maintenance still more to give added *productive* time.

Unit also gives you the industry's *only* one-piece main machinery case. All gears, shafts, and bearings are completely enclosed in a constant oil bath. They last longer . . . require less maintenance attention because lubrication is continuous, automatic.

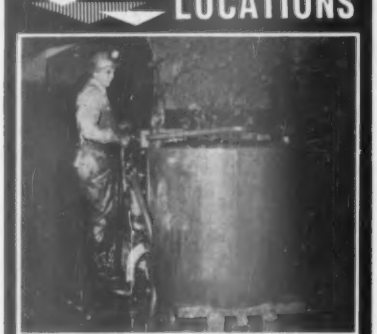
See your nearby UNIT distributor soon and find out more about the ¾-yd. Model 1220 PIPELINER. It's available with 24″ and 30″ width deep grouser shoes, or with 36″ shoes, semi-grouser type.

UNIT

UNIT CRANE & SHOVEL CORP.

6327 W. Burnham St., Milwaukee 19, Wis.

SEE THE LOCATIONS



of underground

LPG STORAGE

on products pipe lines map in this issue of Oil & Gas Journal.

OVER **90%** OF ALL

Underground LPG storage has been constructed by Fenix & Scisson, Inc.

ENGINEERS • CONTRACTORS

FENIX & SCISSON

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WILMINGTON TRUST BLDG., WILMINGTON, DEL.

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CANADIAN KODIAK REFINERIES LIMITED

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HOLDS PARAFFIN IN SUSPENSION

AT SUPPLY STORES

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PIPELINE CONSTRUCTION

Completion: Fall 1961.

UNITED GAS PIPE LINE CO.
Project: 61-mile, 30-in. from West Monroe to Jena, La.
Status: Under way.
Contractor: Panama, Inc.

WASHINGTON GAS LIGHT CO., 1100 H St., NW, Washington 5, D. C.
Project: 10.99 miles, 16-in. gas line near Lanham, Mo., and Lanham to Belair, Md.
Completion: September 1961.
Project: 20.66 miles various size distribution lines, Belair, Md.
Completion: September 1961.
Project: 15.5 miles, 24-in. gas line at Hybia Valley, Va.
Completion: October 1961.
Project: 16 miles of 24-in. from near Alexandria, Va., to Prince Georges County, Maryland.
Status: Approved by FPC.

WESTERN SLOPE GAS CO., Denver, Colo.
Project: 105 miles, 8-in.; 18 miles, 3-in.; 58 miles, 4-in., Ignacio to Del Norte, Colo.
Completion: Oct. 25, 1961.
Contractor: A. J. Curtis & Co.

U. S. Miscellaneous Pipelines

MONSANTO CHEMICAL CO., 800 North Lindbergh Blvd., St. Louis 66, Mo.
Project: 25-mile lines to move petrochemicals between proposed plant at Chocolate Bayou and Texas City.
Status: Planned.

SUNOLIN CHEMICAL CO., 1608 Walnut St., Philadelphia 3, Pa.
Project: Ten 8-in. chemical lines from SunOlin's plant at Claymont, across the Delaware River to Penns Grove, N. J.
Status: Underway.
Completion: Late 1961.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Project: 350 miles of 24-in. coal-slurry line to move West Virginia coal to electric companies in Pennsylvania, New York and New Jersey. (Texas Eastern is working jointly with Consolidation Coal Co., Pittsburgh, Pa.)
Status: Proposed.

Canadian Crude Oil Pipelines

BRITAMOIL PIPE LINE CO., LTD., Box 130, Calgary, Alta.
Project: 64-mile 8-in. line from Dick Lake to Edmonton, Alta.
Status: Under way.

BRITISH COLUMBIA OIL TRANSMISSION CO., Taylor, B.C.
Project: 85-mile, small-diameter gathering system in Blueberry field with transmission line to Taylor.
Completion: December 1961.

FEDERATED PIPE LINES LTD., 304 Sixth Ave. West, Calgary, Alta., Canada.
Project: 10 miles, 4½/6⅝-in. gathering lines.
Completion: Indefinite.

HUDSON'S BAY OIL & GAS CO., LTD., 320 7th Ave., Calgary, Alta.
Project: 10 miles, 6-in., Waterton to Pincher Creek, 29.3 miles, 8-in., Pincher Creek to Carway to connect with Glacier system in U. S.
Status: Pending CENB approval.

INTERPROVINCIAL PIPE LINE CO., Edmonton, Alta.
Project: 90-mile lateral, Hamilton, Ont., to Buffalo, N. Y.
Status: Filed with CNEB.

MATADOR PIPE LINE CORP., Denver, Colo.
Project: 175-mile line from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man.
Status: Approved by CNEB.
Completion: Dec. 31, 1961.

PEACE RIVER OIL PIPE LINE CO. LTD., Box 130, Calgary, Alta.
Project: 161-mile, 12-in. from Kaybob area to Sdmonton with 7.5-mile, 8-in. lateral to Windfall.
Status: Under way.
Completion: Late 1961.

PETROGAS PROCESSING CO., LTD., Calgary, Alta.
Project: 208-mile gathering system, Balzac Alta., region.
Completion: Oct. 15, 1961.
Contractor: Banister Construction Co. Ltd.

COLLINS RADIO COMPANY

Has immediate openings in

Microwave-Carrier Sales

Expansion of operations and a redistricting of sales territories have created several attractive opportunities for persons qualified in technical sales. Those selected will receive product orientation at Dallas before going into the field.

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INTERNAL PIPE COATING CONTRACTORS

★ *Increased Thru-put*
★ *Cuts Maintenance Cost*
★ *Storage Protection*
★ *Cleaner End Products*
★ *Protects Against Corrosion*

Internal Cleaning and Coating at or Near Mill
C-R-C Patented Machines

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BEAUMONT, TEXAS
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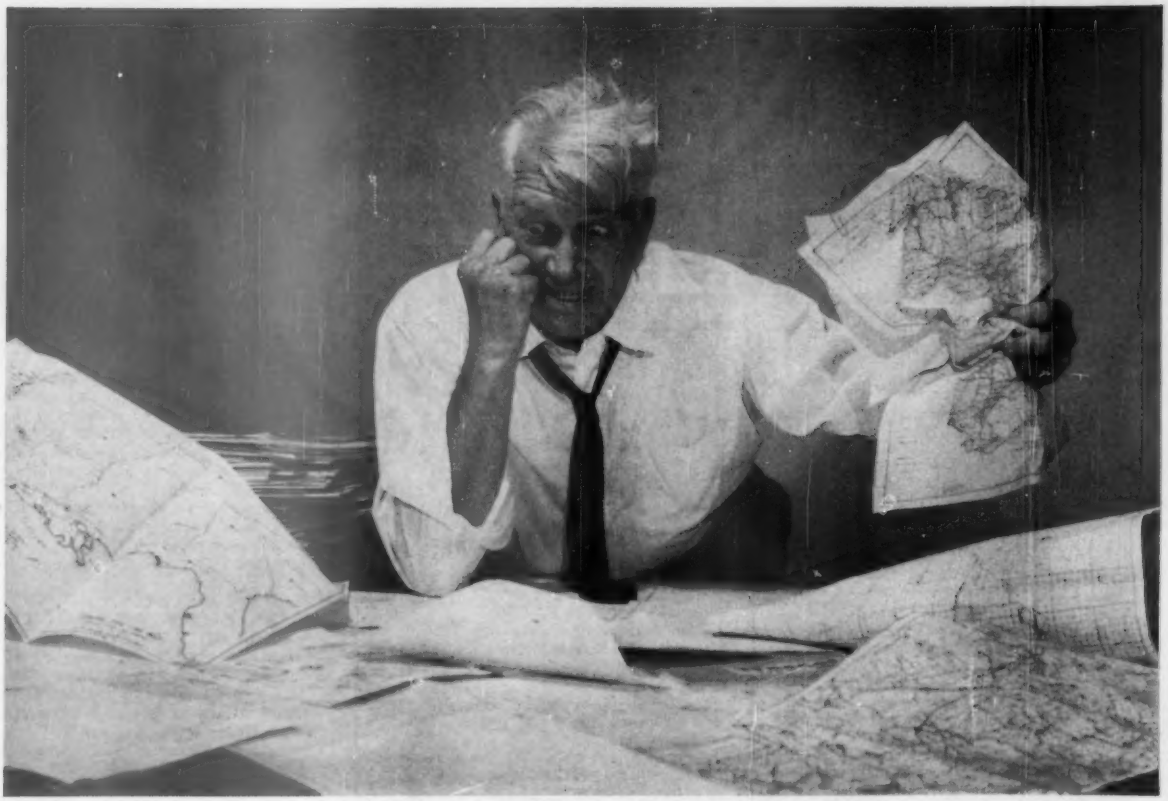


EVER LOSE YOUR HEAD---
TRYING TO FIND A PIPELINE?

WHY GET LOST in a jungle of outdated and incomplete pipeline maps! You can find what you want at a glance by using the new wall-size map which came to Oil and Gas Journal subscribers as part of this week's issue.

HIGHLY-TRAINED editors and artists did the sifting for you. They examined hundreds of small maps and documents to bring Journal readers a timely, one-piece map—showing crude and products lines in relation to refineries and LPG storage areas in the U. S. and Canada.

THE WEEK-TO-WEEK Journal coverage is like that, too. From the Newsletter up front to the Statistics Section in back, the Journal offers its readers the broad sweep of interrelated oil news, plus articles in depth on technology, exploration, and marketing. For broad and deep coverage, read the Journal—every week. There's plenty in it for you!

As a service to readers, additional copies of the new map will be available at $2.50 each. Write Reader Service, The Oil and Gas Journal, Box 1260, Tulsa.

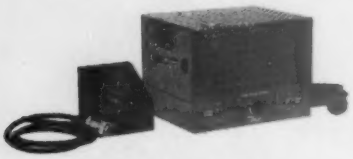
the OIL AND GAS JOURNAL
Published Weekly
211 S. Cheyenne, Tulsa, Okla.

Protective Coating Inspection Problems?

Here's Your Answer

No matter whether you're coating a pipeline or a chemical tank, continuity is vital. Use of a Tinker and Rasor Holiday Detector while the job is open, can save days of downtime later on.

• PLANT AND YARDS



Tinker and Rasor
EPAC Holiday Detector or J-1ACM

EPAC operates off 110 volts A.C. power for stationary coating operations. Internal voltage adjustment from 5,000 to 20,000 volts or with external variable transformer from 500 to 6,000 volts, or 5 KV to 20 KV.

J-1ACM for continuous inspection on coating and wrapping machines which use water for cooling.

• PIPE

Tinker and Rasor
E-P or E-4 Holiday Detectors

Output adjustable from 5,000 to 20,000 pulsating voltage.

E-P—All purpose for larger diameter pipe, damp or dry climate, pre-fab film or hot applied coatings.

E-4—Lower cost, dry surface type of detector specifically designed for smaller diameter pipe and flat surfaces.

• THIN FILM

Tinker and Rasor
M-1 Holiday Detector

For painted or sprayed thin film coatings such as vinyls and epoxies. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4-lbs. total weight.

• UNDERGROUND

Tinker and Rasor
Pearson-type Holiday Detector

For detecting holidays and electrical shorts without uncovering the pipeline. Completely transistorized . . . generates 15 watt, 750 cycle, stable A.C. Audio-frequency signal. Adaptable to null search method.

Tinker and Rasor has prepared a complete data kit which describes the null search system as well as other recommended procedures for inspecting protective coatings. Material includes technical data on equipment, general discussion of types of detectors, theory of operations, etc.

Engineering Note:
To insure a perfect application, include Tinker and Rasor Holiday Inspection. Write for specification guide.

Quality Control for Coating Application

TINKER & RASOR

417 Agostino Road, P.O. Box 281 • San Gabriel, California

PIPELINE CONSTRUCTION

RANGELAND PIPE LINE CO., Calgary.
Project: 111-mile line from Cessford field to Calgary.
Status: Pending approval of Alberta government.

ROYALITE OIL CO., LTD., Calgary, Alta.
Project: 26.5 mile, 8-in. Jumping Pound and Wildcat Hills absorption plants to Valley Pipe Line near Calgary.
Status: Bids called for Oct. 31.

TEXACO EXPLORATION CO., Calgary, Alta., Canada.
★ Project: 22.2 miles, 8⅝-in. loop on Rimbey-Westrose section of existing line.
Status: Pending Alberta Conservation Board approval.

TRANS-PRAIRIE PIPELINES, LTD., 12912 125 Ave., Edmonton, Alta.
Project: Expansion of gathering system in British Columbia, 40 miles, 4-in. from Taylor to Dawson Creek; 30 miles, 6-in. from Boundary Lake to Taylor. 75 miles, 8-in. from Taylor to Milligan Creek, 11 miles, 4-in. from Milligan Creek to West Beaten; and 4 miles, 8-in. near Taylor station.
Status: Under way.
Contractor: Banister Construction Co., Ltd., Edmonton.
Completion: Fall, 1961.

WESTERN PACIFIC PRODUCTS & CRUDE OIL PIPELINES, LTD., 1155 West Georgia St., Vancouver 5, B. C.
Project: 500-mile, 12-in. from Taylor, B. C., to Kamloops to connect with the Trans Mountain line to Vancouver.
Status: Under way.
Contractors: Canadian - Bechtel, north; Dutton-Williams, south.
Completion: Late 1961.

Canadian Natural Gas Pipelines

ALBERTA GAS TRUNK LINE CO., LTD., Calgary, Alta.
Project: 226 miles of 36-in. and 125 miles of 30-in., plus laterals in southern Alberta including 58 miles of 22-in. and 64 miles of 16-in. (Part of a 1,400-mile system Alberta to San Francisco.)
Contractors: Majestic Contractors, Ltd., Edmonton, haas 113 miles of 36-in. from Crowsnest Pass to Priddis, 63 miles of 30-in. from Rocky Mountain House to Cynthia, and 38 miles of 22-in. lateral to the Rimbey region. Mannix Co., Ltd., Calgary, has 113 miles of 36-in. from Priddis to Rocky Mountain House. Dutton-Williams Brothers, Ltd., Calgary, has 62 miles of 30 in. from Cynthia to near Whitecourt, Alta., as well as a 20-mile, 22-in. lateral to the Whitecourt area. Piggott Construction, Ltd., Edmonton, has 64 miles of 16-in. lateral from Crowsnest Pass to Carway, Alta., on the U. S. border.
Projects: Laterals to tie in with the above project: 15 miles of 12-in. to Buck Lake, 23 miles of 22-in. to East Calgary, 15 miles of 16-in. to Carstairs, 4 miles of 8-in. to Sarcee, and 10 miles of 10-in. built will connect Kaybob, Berland River, Lovett River, and Stolberg.
Completion: Dec., 1961.

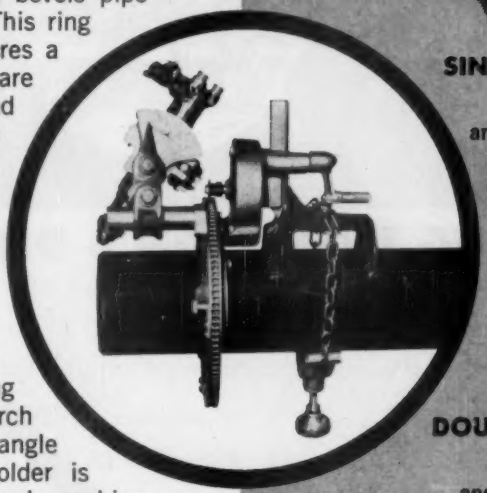
ALBERTA NATURAL GAS CO., LTD. (Pacific Gas & Electric Co., San Francisco, and Westcoast Transmission, Calgary.)
Project: 108 miles of 36-in. from Crowsnest Pass across southeastern British Columbia to the U. S. border near Eastport, Idaho. (Part of 1,400-mile project from Alberta to San Francisco.)
Contractor: Price Poole of Canada, Ltd. (Canadian Bechtel, Inc., Toronto, is engineering manager.)

Presenting

CROSE-PERRAULT'S
NEW • COMPACT
CUTTING & BEVELING MACHINES

Handle pipe sizes from 1½" to 48"

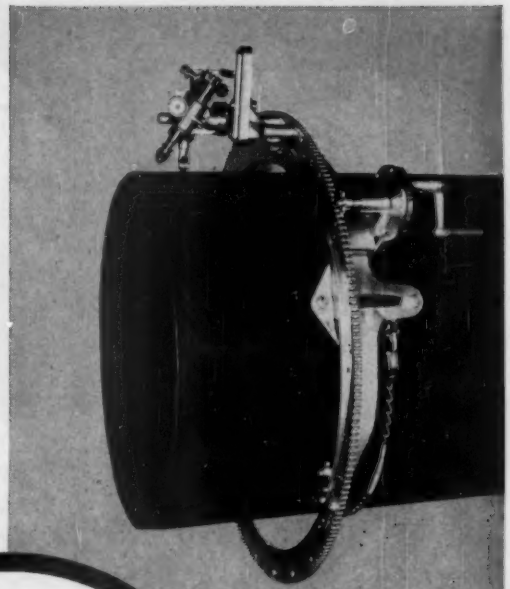
Because of the new compact design these machines will cut and bevel coated pipe with much less cutback. A full circle traveling ring cuts and bevels pipe simultaneously to assure accuracy. This ring eliminates jerky movement and insures a cut so smooth that buffing costs are negligible. Easy to install on closed section of pipe. Model "O" beveling machine handles pipe from 1½" to 4".



MODEL "O"
Compact Cutting and Beveling Machine

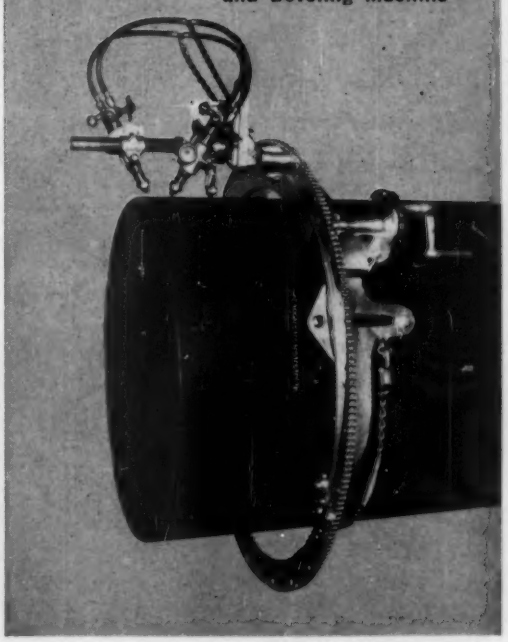
Models "1" thru "8" handle pipe from 4" thru 48". Adaptors are available for conversion to double cutting machines. Accurately calibrated torch holder allows torch to be set at an angle to cut any desired bevel. Torch holder is designed to accomodate any standard machine cutting torch. Simple adjustment required to adapt machine to different pipe sizes. Field tested. Light weight, rigid, constructed of finest available aluminum alloy. Machines accomodating up to 14" pipe are equipped with standard torch holder. Machines accomodating 16" pipe and larger are equipped with out-of-round attachment to allow the cutting flame of the torch to follow the surface contour of the pipe, insuring true and accurate bevel cuts.

Write today for more information.



SINGLE HEAD MODEL
Compact Cutting and Beveling Machine

DOUBLE HEAD MODEL
Compact Cutting and Beveling Machine



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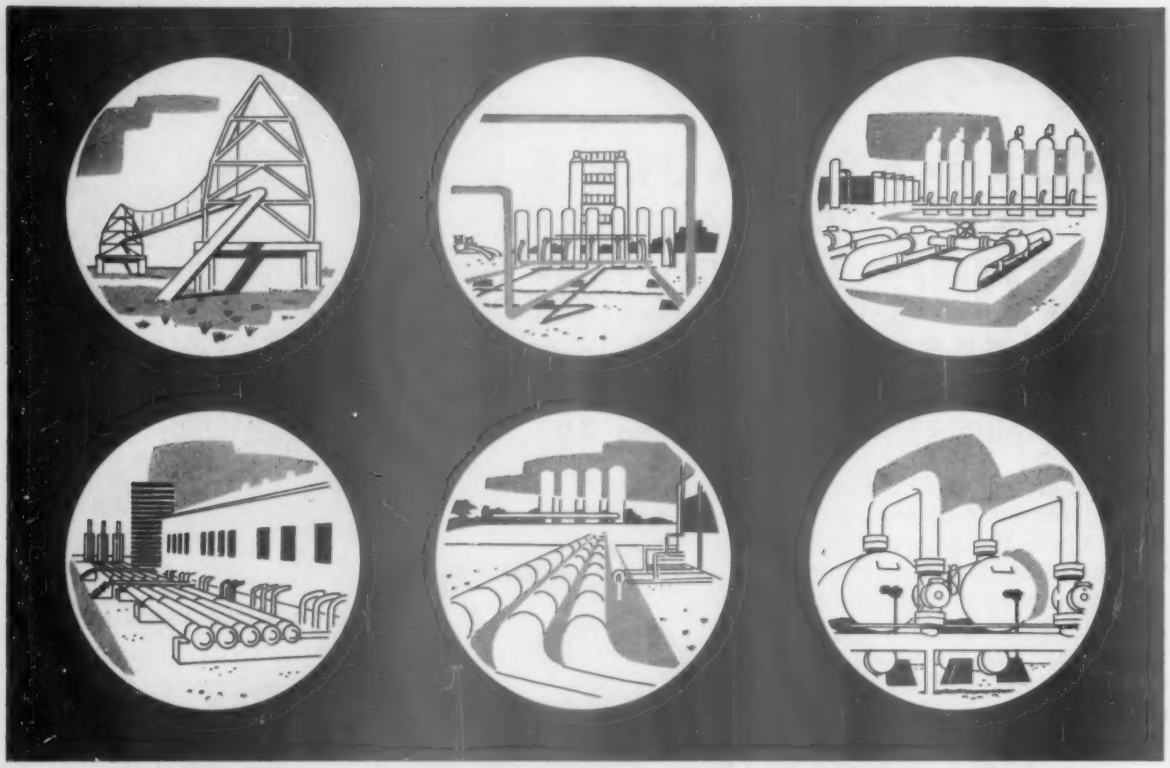

MEETING TOMORROW'S DEMANDS...TODAY

Oklahoma Natural Gas Company's integrated pipeline system — for transmission and distribution — traverses the greater part of the State of Oklahoma.

As a "working partner" in the state's industrial expansion program, ONG is actively engaged in the development of new natural gas reserves. We are always interested in tying in newly discovered gas production to our pipeline system.

New and expanding industry can be assured that ONG will cooperate to the fullest toward providing an ever-plentiful, economical supply of natural gas — for today's requirements, for tomorrow's increased demands.

ONG

OKLAHOMA NATURAL GAS CO. TULSA, OKLAHOMA

PIPELINE CONSTRUCTION

Completion: Dec., 1961.

CARTIER GAS CORP. (St. Maurice Gas Inc., and Consumers Gas Co., 19 Toronto St., Toronto.)
Project: Transmission and distribution in eastern townships and through to Quebec City in Quebec Province.
Status: Proposed.

GAS TRUNK LINE OF BRITISH COLUMBIA, LTD., Pacific Bldg., Calgary, Alta.
Project: 245-mile, 30-in. extension of Westcoast Transmission system from Taylor, B. C., to Fort Nelson.
Status: Delayed to 1963 or 1964.

MAGNA PIPELINE CO., LTD., Nanaimo, Vancouver Island, B. C.
Project: 53 miles of parallel 7-in. reinforced plastic pipe to serve Vancouver Island, B. C.
Status: Approved.
Completion: 1963.

NORTHERN ALBERTA PIPE LINES, LTD., Edmonton, Alta.
Project: 110-mile trunk line, plus gathering system, from Las La Biche, in McMurray vicinity, to Edmonton.
Status: Pending provincial approval.

SASKATCHEWAN POWER CORP., Regina, Sask.
★ Project: 88 miles, 14-in., Hatton to Success, Sask.
Status: Under way.
Completion: Nov. 1, 1961.
Contractor: Robb Construction.
Project: 35-mile, 4 and 6-in. line, Canora to Sturgis.
Completion: 1961.

SARATOGA PROCESSING CO., LTD., 406 Petroleum Building, Calgary, Alta.
Project: 67 mile gathering system (43 miles 16-in., 24 miles 4-10-in.) for Coleman, Alta., processing plant.

WESTCOAST TRANSMISSION CO., LTD., Calgary, Alta.
Project: 688-mile, 30-in. loop of British Columbia-Washington line.
Status: Proposed.
Project: See Alberta Natural Gas Co., Ltd., for joint project.)

Foreign Crude Oil Pipelines

ABU DHABIE MARINE AREAS, LTD. (partly owned by British Petroleum Co., Britannic House, Finsbury Circus, London E.C. 2).
Project: 20 miles of 18-in. from offshore Persian Gulf pool to Das Island.

ARABIAN AMERICAN OIL CO., 505 Park Ave., New York 22.
Project: 29-mile, 30/32-in., partial looping, Safaniya to Khursaniyah.
Status: Under way.
Completion: October 1961.
Project: 30-mile, 24-in. Safaniya offshore gathering line.
Status: Under way.
Completion: January 1962.
Project: 27-mile, 24-in. crude line from northern Safaniya to southern Safaniya.
Status: Planned.
Completion: Second quarter 1962.
Contractor: Aramco-Bechtel.

BASRAH PETROLEUM CO., London, England.
Project: 20 miles, 16-in. gathering lines, Rumaila.
Contractor: Mothercat Co., Ltd.
Completion: September 1961.
Project: 37-mile line from Rumalia field to power plant at Basra.
Status: Contract let.
Completion: March 1962.
Contractor: SAIPEM.

CIE. de RECHERCHE et d'EXPLOITATION PETROLIERE au SHARA, Paris.

the line of MOST RESISTANCE

PIPE LINE PRODUCTS

■ *Midwestern's line of corrosion-resistant products offers you the most completely engineered materials in the pipe line industry. Every Midwestern product is backed by years of successful performance under the toughest field conditions. The Midwestern Line includes* **KERMAC** *outerwrap . . .* **KEYSTONE** *asbestos felt . . .* **KAPCO** *rock shield . . .* **COROMAT** *underground wrap . . .* **GLASFAB** *handwrap . . . and* **POLYKEN** *tape coatings.* ■ *Midwestern's sales representatives are your line of most assistance in providing the materials you require for solving your particular pipe corrosion problems. Through long experience, they are thoroughly qualified to meet your needs, regardless of the application specified. Call your nearest Midwestern representative TODAY . . . he'll respond quickly — and at your convenience!*

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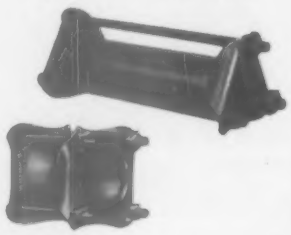
• New York, N.Y. (export)
• Caracas, Venezuela

Wherever oil flows... There's a Dresser® quality piping product that's right for the job

FOR GROOVED END PIPE

Dresser "KUPL + LOK" (TM) Couplings and Fittings, 500# & 1000# types.

FOR PLAIN-END PIPE



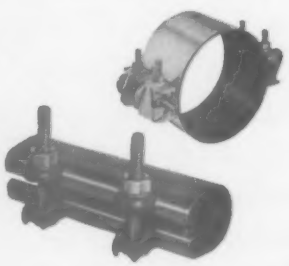
Style 40 Long Sleeves for spanning gaps between pipe ends.

Style 38 Couplings for regular applications.

FOR SMALL DIAMETER PIPE

Dresser Compression Couplings and Fittings . . . Sizes thru 2".

FOR PIPE REPAIRS



"360" Clamp for Asbestos-Cement Pipe "Handiband" Clamp for Steel Pipe

All the pipe joints you need for fast installation on tank batteries, gathering lines, mud pumps, salt-water disposal lines . . . now in stock at your supply store.

All the easy-to-install, permanent repair products that enable you to stop leaks fast . . . now in stock at your supply store.

Insist on Dresser quality when you buy pipe couplings, fittings and repair products. Every Dresser product is clearly marked . . . your guarantee of highest quality.

Bradford, Pennsylvania
Chicago
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DRESSER MANUFACTURING DIVISION

ONE OF THE DRESSER INDUSTRIES

How Transco takes up the Slack Between Gas Supply & Consumption

Storing natural gas underground in depleted gas producing areas of Pennsylvania is an important part of Transco's business. The company's customers have large space heating loads in the winter which would be costly to serve if pipe line facilities had to be built between Texas and New York just for this purpose. Instead, Transco has developed for its customers a sort of "Christmas Club" whereby the customers authorize the company to store gas for their accounts in the low load periods of summer, delivering this gas in winter over short lines from the storage fields which are close to the metropolitan market area. Thus, while purchasing gas on a year-round basis, Transco, through underground storage, takes up the slack between supply and ultimate consumption of natural gas, effecting operational economies for both producers and marketers.

CARRYING NATURAL GAS FROM TEXAS AND LOUISIANA TO THE MARKETS WHERE THE MOST PEOPLE ARE.

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

PIPELINE CONSTRUCTION

Project: 40 miles, 4-8-in. gathering lines, El Adeb Larache field.
Status: Proposed.
Contractor: Socoman.
Completion: January 1962.

COUNCIL FOR MUTUAL ECONOMIC AID (Comecon).
Project: 2,800-mile system from the Volga-Ural oil fields in Russia to East Europe satellite countries.
Status: Construction under way in Poland, Hungary, and Czechoslovakia.

EMPRESA NACIONAL CALVO SOTELO, General Pardenas 55, Madrid, Spain.
★ Project: 150-mile, 14-in. Malaga to Puertollano.
Status: Planned.
Completion: 1962.

ENI, Milan, Italy.
Project: Central European System, 325 miles, 22-26-in., 300 miles, 14-18-in. from Genoa, Italy, to Aigle, Switzerland, to Ulm, Germany, with branches to Ingolstadt and Stuttgart.
Status: Underway.

IRANIAN OIL EXPLORATION & PRODUCING CO.
Project: 30 miles of 20-in. and 22 miles of 16-in. looping of Agha Jari to Bander Mashur line.
Status: Planned.

IRAQ PETROLEUM CO.
Project: Two 25-mile. 32-in. crude lines to offshore loading dock in Persian Gulf.
Status: Under way.

IRAQ PETROLEUM CO., LTD., 214 Oxford St., London W 1, England.
Project: Looping of Kirkuk-Mediterranean system 66-mile between K-1 and K-2 stations and 81-mile between K-3 toward Syria. In Syria, a 28-mile section of 30-in. is under way.

KUWAIT OIL CO., LTD., Burgan House, London, England.
Project: 31-mile, 24-in. crude line from Minagish to Ahmadi South tank farm.
Status: Planned.
Completion: Mid-1962.

MENE GRANDE OIL CO., Apartado 709, Caracas, Venezuela.
Project: 16-in. line at Block 11, Maracaibo.
Completion: December 1961.

OASIS OIL CO. OF LIBYA, 1270 Avenue of the Americas, New York 20, N. Y.
Project: 86-mile, 30-in. from Dahra field to El Sider; 36-mile, 20-in. from Mabruk to 30-in. line.

OIL INDIA, LTD., (Burmah Oil Co. and Assam Oil Co., two-thirds, and India Government, one-third.)
Project: 720 miles in northeast India, 250 miles of 16-in. from Nahorkatiya to Noonmati and 470 miles of 14-in. from noonmati to Barauni.
Contractors: Mannesmann, Germany, and SAIPEM, Italy.
Status: Under way.
Completion: 16-in. system, 1961.

PETROLEO BRASILEIRO S.A. (Brazil).
Project: 250-mile line from Rio de Janeiro to Belo Horizonte refinery site.
Status: Under consideration.
Project: 35 miles of 8 to 12-in. pipe from Buracica to Candeia.
Contractor: Techint, Inc., Milan, Italy.
Project: 80 miles of 24-in. to tie in to proposed Caxias refinery near Rio de Janeiro.
Status: Planned.

PHILLIPS PETROLEUM CO., Bartlesville, Okla.
Project: 14-in. line in Block 17, Lake Maracaibo, Venezuela.
Status: Planned.
Contractor: Chicago Bridge & Iron Co.

RHEIN-DONAU OELETUNG, G.m.b.H., Germany.
Project: Extension of South European Pipeline from Karlsruhe to Ingolstadt.
Status: Proposed.

ROYAL DUTCH-SHELL.
Project: 12-mile line from Gore Bay, Australia, to Royal Dutch-Shell's Clyde refinery.
Status: Planned.
Project: 161 miles 20-in. line from Tandzung field to Balikpapan refinery, Borneo.
Status: Planned.
Contractor: Williams Brothers Overseas, Ltd., Tulsa, and John Brown, Ltd., London.
Completion: January 1, 1962.

SINCLAIR VENEZUELAN OIL CO., Apartado 1706, Caracas. Venezuela.
Project: 17.35 miles, 8-in. crude line from East Aguasay to south bank of Tonoro River to connect with existing 8-in. line.
Status: Planned.
Completion: Late 1961.

SNAM-SUEDPETROL, Milan, Italy.
Project: 20-in. crude line from Genoa to Ingolstadt, Austria, via Switzerland.
Status: Planned. Construction expected to begin in 1961.

SOUTH EUROPEAN PIPELINE CO. (Jersey Standard, Caltex, Shell, British Petroleum, and 12 other firms.)
Project: 419-mile, 30 in. line from Lavera, near Marseille, to Strasbourg, with 40-mile extension to Karlsruhe, Germany. This may be extended into lower Batavia with a 155-mile, 22-in. segment.
Status: Under way.
Completion: 1963.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: 2,315-mile, 28-in. Trans-Siberian

GALVOMAG ANODES USED TO PROTECT 300-MILE LINE

This pipe line company had an old, bare, 8-inch product line that ran 300 miles across three states. The increasing number of corrosion leaks made it imperative to take corrective measures. CSI was awarded a cathodic protection contract on a competitive bid basis.

CSI engineers made soil resistivity tests, determined the size of anodes to use, and staked the anode locations. Then CSI's experienced crews installed 2300 Galvomags, the high-potential magnesium anodes developed by The Dow Chemical Company. CSI also furnished all other necessary materials and equipment, including augers and ditchers.

The job was done to the complete satisfaction of the pipe line inspectors.

You, too, will find it pays to call our stockholder employees—for engineering consultation, installation services, and quality cathodic protection supplies—for both rectifier and magnesium anode installations. Estimates or quotations without obligation. Call or write today.

CSI

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Tel. CHerry 1-7795

General Office, Tulsa, Okla.
Mailing Address:
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Tel. Circle 5-1351

This veteran Kerotest inspector is setting up a flaw-finding magnetic field between the two electrodes. He'll cover every inch of the casting – electronically seeking out minute and hidden cracks, sand holes and other potential failure points. This swing check valve body must receive his unqualified stamp of approval before it is accepted.

Magnetic particle inspection is one of more than half dozen laboratory and manufacturing quality control procedures at Kerotest. Kerotest standards of quality insure *consistent* production of trouble-free valves. A Kerotest valve in the line is your best insurance against costly down time . . . your best protection against failure in critical and hazardous applications.

Kerotest Cast Steel Swing Check Valves

High quality Kerotest cast steel swing check valves are available in primary service pressure ratings ranging from Series 150 to Series 1500. They are supplied in all regularly used sizes for all types of service in oil, gas, steam, water, chemical, petro-chemical, marine and industrial installations.

Send for your free copy of the new, informative Kerotest booklet. It's packed with working tables, dimensions, specifications and other helpful information.

KEROTEST
Quality Controlled Features

- Durable wall sections for maximum safety
- Designed to permit passage of line scraper equal to inside diameter of pipe
- Threaded bottom seating type rings made to allow full flow, obstruction-free passage
- Rigidly supported disc allows self-alignment
- Counterbalanced discs available for minimum pressure applications

There is a Kerotest Cast Steel Valve available for every class and condition of service

KEROTEST MANUFACTURING COMPANY
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In Canada . . . Kerotest Cast Steel Valves are manufactured and distributed exclusively by Guelph Engineering Company, Guelph, Ontario, Canada

KEROTEST®

PIPELINE CONSTRUCTION

crude-products line from Ufa and Tuimazy fields, Bashiria, to Irkutsk.
Status: Under way.

YACIMIENTOS PETROLIFEROS FISCALES (Argentina), Buenos Aires.
Project: 390 miles, 14-in. from Neuquen Province to Bahia Blanca.
Status: Under way.
Project: 625 miles of 12-in. from Mendoza to San Lorenzo.
Status: Planned.

Foreign Products Pipelines

ARABIAN AMERICAN OIL CO., Dhahran, Saudi Arabia, and 505 Park Avenue, New York.
Project: 37 miles of 8-in. LPG line from Abqaik to 'Ain Dar.
Contractor: Aramco-Bechtel.
Completion: 1961.

BRITISH PETROLEUM CO., London.
Project: 12 mile, 4-6-in. from sealoading line to air terminal on Bahrain.
Contractor: Mothercat.

CALTEX, PAKISTAN, Karach, Pakistan.
Project: 15-mile, 4-12-in. harbor installation, Karachi.
Completion: September 1961.
Contractor: Mothercat.

CIE. FRANCAISE DE PETROLES, Paris, France.
Project: 187-mile, 8-in. condensate line from Hassi R'Mel dehydration plant to Haoud-el-Hamra station on Hassi Messaoud-Bougie crude oil line.
Status: Under way.

INDIA GOVERNMENT.
Projects: 600-mile line from Barauni to Delhi via Kanpur, Lucknow, and Allahabad; 300-mile dual crude and products line from Bombay to Bhusaval; 120-mile products line from Bombay to Poona to be extended 300 miles, later, to Hyderabad; and a 350-mile products line from Cochin to Madras via Bangalore.
Status: Proposed.

NATIONAL IRANIAN OIL CO., Tehran, Iran.
Project: 360 miles of 8-in. from Rey to Meshed, Iran.
Status: Under way.
Contractor: William Brothers, Tulsa.

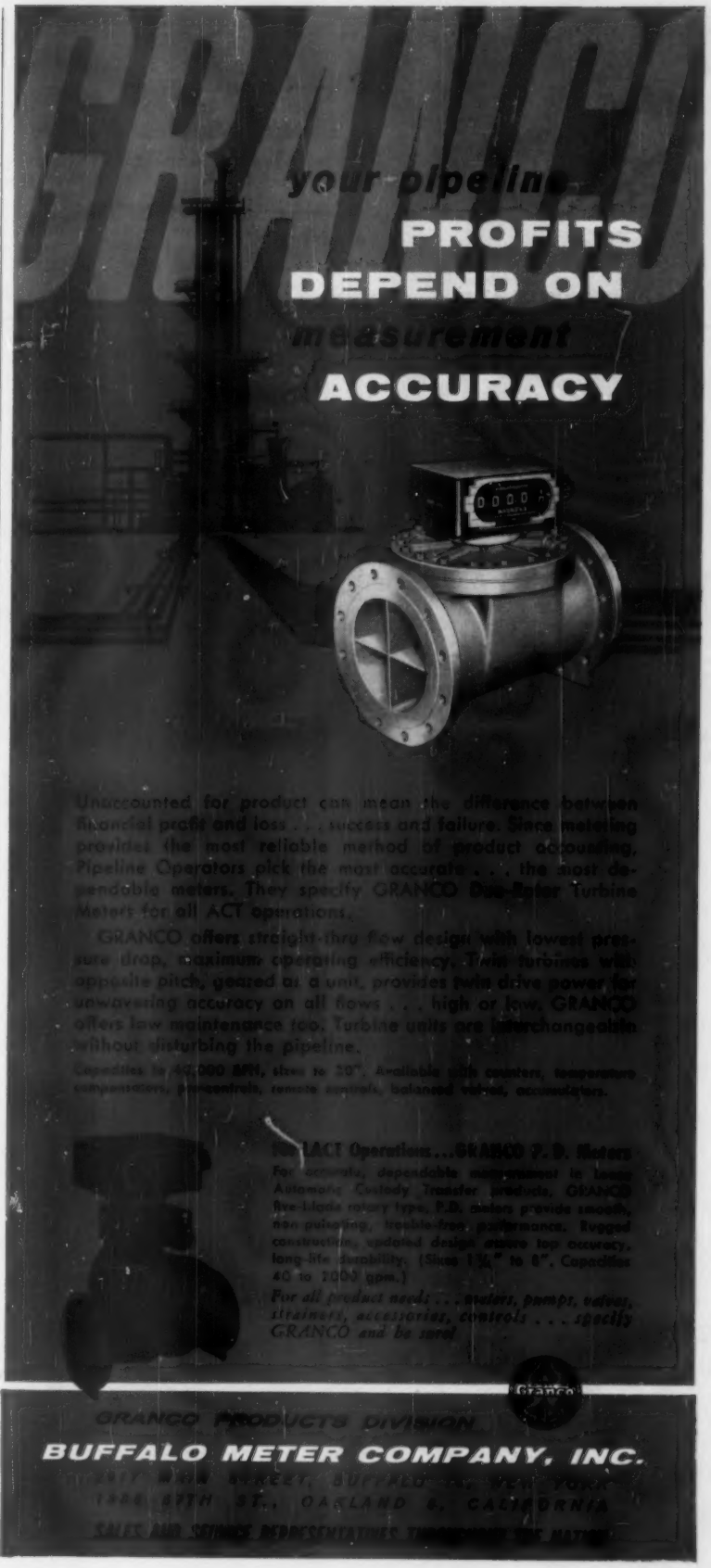
PETROLEOS MEXICANOS, Avenida Juarez 92-94, Mexico City, Mexico.
Project: 350-mile, 12-in. Minatitlan to Mexico City.
Status: Planned.
Completion: December 1962.
Project: 270 miles of 8-in. from Torreon to Chihuahua.
Status: Under way.
Completion: February 1962.

PIPELINES OF PUERTO RICO, San Juan.
Project: 95 miles 8-in. from Penuelas to Catano.
Status: Approved by PSC.

SYRIAN PIPELINE.
Project: About 316 miles, 6-in. from Homs to tank farms in the Damascus, Aleppo, and Latakia areas.
Status: Underway.
Completion: 1962.
Contractor: Technit.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: 2,315 miles of 29-in. Trans-Siberian crude-products line from Ufa and Tuimazy fields in Bashira to Irkutsk.
Status: Under way.
Project: 700 miles from Novo-Kuibyshev refinery to Bryansk.
Status: Under way.

YACIMIENTOS PETROLIFEROS FISCIALES (Argentina), Buenos Aires.


GRANCO
your pipeline
PROFITS
DEPEND ON
measurement
ACCURACY
Unaccounted for product can mean the difference between financial profit and loss . . . success and failure. Since metering provides the most reliable method of product accounting, Pipeline Operators pick the most accurate . . . the most dependable meters. They specify GRANCO Duo-Rotor Turbine Meters for all ACT operations.
GRANCO offers straight-thru flow design with lowest pressure drop, maximum operating efficiency. Twin turbines with opposite pitch, geared as a unit, provides twin drive power for unwavering accuracy on all flows . . . high or low. GRANCO offers low maintenance too. Turbine units are interchangeable without disturbing the pipeline.
Capacities to 40,000 BPH, sizes to 20". Available with counters, temperature compensators, pressure controls, remote controls, balanced valves, accumulators.
For ACT Operations...GRANCO P. D. Meters
For accurate, dependable measurement in Lease Automatic Custody Transfer products, GRANCO five-blade rotary type, P.D. meters provide smooth, non pulsating, trouble-free performance. Rugged construction, updated design assure top accuracy, long-life durability. (Sizes 1½" to 8". Capacities 40 to 2000 gpm.)
For all product needs . . . meters, pumps, valves, strainers, accessories, controls . . . specify GRANCO and be sure!
Granco
GRANCO PRODUCTS DIVISION
BUFFALO METER COMPANY, INC.
2017 MAIN STREET, BUFFALO 14, NEW YORK
1386 67TH ST., OAKLAND 6, CALIFORNIA
SALES AND SERVICE REPRESENTATIVES THROUGHOUT THE NATION

FENIX & SCISSON INC.

DESIGNED AND CONSTRUCTED

35 OF THE 38

mined underground storage caverns for LPG shown on the Products Pipe Lines map in this issue of the Oil & Gas Journal.

FENIX & SCISSON INC.

5805 E. 15TH • TULSA 12, OKLAHOMA
WILMINGTON TRUST BLDG., WILMINGTON, DEL.

PIPELINE CONSTRUCTION

Project: 652 miles of 10-in. from Lujan de Cuyo to Buenos Aires.
Status: Planned.

Foreign Natural Gas Pipelines

BASRAH PETROLEUM CO., LTD., 214 Oxford St., Oxford Circus, London W. 1, England.

GASES NATURALES DE COLOMBIA, S.A. (Owned 50% by Colombian Petroleum Co., is affiliated with Mobil International and Texaco, and 50% local.)
Project: 140 miles of 10-in. from Cicuo field to Barranquilla.
Completion: Late 1961.

INTERNATIONAL GAS CO., Los Angeles, Calif.
Project: 1,840-mile, 30-in. gas line from Reynosa to Mexicali via Monterrey, Mazatlan, etc.
Status: Proposed.

ISRAEL GOVERNMENT and private interests.
Project: 75 miles of 16-in. to power a plant at Ashdod Yam on the Mediterranean coast.
Status: Planned.

NOGAS, Vienna, Austria.
Project: 82 miles of 8 and 10-in. to connect Traismauer and Amstetten in Austria.
Contractor: Williams Brothers, Tulsa.

PAKISTAN INDUSTRIAL DEVELOPMENT CORP.
Project: 1,000-mile system from Sui field to Lyallpur, Lahore, Daudkhel, Islamabad, Rawalpindi, and Wah. This would require a loop to an existing 310-mile 16-in. line from the Pakistan petroleum field to Multan.
Status: Proposed.

PAKISTAN PETROLEUM CO.
Project: 145 miles of 8-in. from Sylhet field to Daccq, East Pakistan.
Status: Proposed.

PETROLEOS MEXICANOS, Avenida Juarez 92-94, Mexico City, Mexico.
Project: 270 miles of 12-in. from Torreon to Chihuahua.
Status: Under way.
Completion: December 1961.

SOC. SICILIANI METANDOTTI (SOSIM).
Partners include Edison Power, Italcementi, Fiat Motor, Sicilian SGES Power, Bombrini Parodi Delfino Chemical, and Montecatini.
Project: 560 miles from Hassi R'Mel gas field, Algeria, to Cape Bon, Tunisia, 77 miles across the Sicilian Channel, into northern Italy and beyond.
Status: Engineering studies under way.

STANDARD - VACUUM OIL CO., New York.
Project: 60 miles of 10-in. from Radja field to Palembang, Sumatra, to supply fertilizer plant planned by the government.
Status: Planned.
Completion: 1962.

SYRIAN LINE.
Project: 316 miles of 6-in. from Homs refinery to Damascus, Aleppo and Latakia.
Status: Under way.
Contractor: Techint, Inc., Milan, Italy.
Completion: Late 1962.

TEIKOKU OIL CO. and **TOKYO GAS CO.**
Project: 200-mile, 12-in. system from Kubiki gas field.
Status: Proposed.

TRINIDAD & TOBAGO ELECTRICITY COMMISSION, Port - of - Spain, Trinidad.
Project: 42-mile, 16-in. gas line from Penal fields to Port-or-Spain.
Status: Planned for 1962.

TENNESSEE GAS TRANSMISSION CO., Box 2511, Houston, Tex.
Project: 1,100-mile, 30-in. line from Reynosa, to San Luis Rio Colorado, near the California border.
Status: Pending FPC, California PUC approval.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: New line from gas fields in western Ukraine to the Polish border.
Status: USSR has signed agreement with Poland.
Project: 250-mile line from Ust-Vilyuisk field to the Siberian cities of Yakutsk and Pokrovsk, plus feeder lines to supply villages in the Lena River Valley.
Status: Planned.
Completion: Date not set yet.
Project: Two parallel, 40-in. lines, each over 1,300 miles long, from Gazli, near

Just tear off your Bandaid...

send it and your old file to:
H & M PIPE BEVELING MACHINE CO.

and we'll know you're interested in finding out more about the H & M "BEVEL-LAND" Grinder. The "BEVEL-LAND" Grinder eliminates time-consuming handwork and assures better quality welds by accurately placing the land on the bevel. The grinder is electric or air powered and is available in two models — one for 6 to 12 inch pipe and one for 14 to 30 inch pipe. Larger models are available on request.

PATENT NO. 2,869,293

H&M

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311 E. Third St. LUther 3-0241
TULSA, OKLAHOMA

S. E. HUEY & CO.

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BERNHARDT BLDG.

MONROE, LA.

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PIPE LINE SURVEYS

1st

IN CORROSION PREVENTION

BITUMASTIC
REG. U. S. PAT. OFF
HOT & COLD APPLIED COATINGS

Carey
PIPELINE FELT, PADDING & GLASS PIPE WRAP

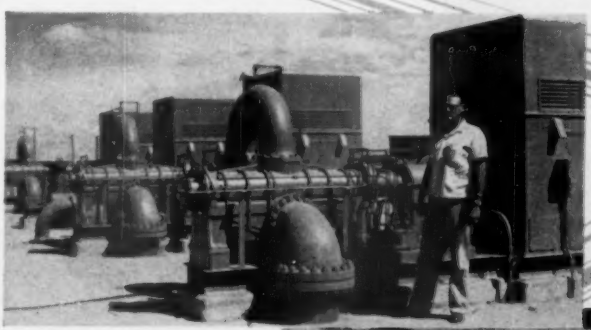
TAPECOAT
PIPE JOINT PROTECTION

MAVOR • KELLY
COMPANY

M & M BUILDING
HOUSTON • CA 2-2203
1038 4th Street, Gretna, La.
FOrest 1-1861

8102

Warren's High Pressure Screw Pump is proving its true economy with pumping efficiencies of 75% to 85% – on either high or relatively low viscosities



Warren #8CB Screw Pumps handling crude oil at a primary pumping station.

In crude line, product line and refinery jobs Warren High Pressure Screw Pumps —

- develop continuous flow
- can be direct driven . . . speed reduction gears are not necessary
- maintain constant capacity and pressure, even on oil containing foreign matter
- are suitable for unattended stations.

WRITE FOR SELECTION NOMOGRAPH #252

WARREN

CENTRIFUGAL · SCREW · RECIPROCATING · GEAR

WARREN PUMPS, INC.

WARREN, MASSACHUSETTS

-0-1

"... growth through leadership"

The knight has long been a symbol of leadership. The Majestic knight is the symbol of an established leader in the field of pipeline construction. Majestic has the men, the machines and the methods for leadership in all phases of pipeline construction from the most remote fields direct to the consumer.

Pipelines are built better, Majestically . . .

Majestic
contractors inc.

Head Office: 1902 Tennessee Building, Houston

VALVE LEAKS

We know a guy who will lie awake all night listening to a leaky faucet dripping. . . . Yet he loses no sleep over the fact that he has an adsorption type hydrocarbon recovery plant with leaky valves. . . . AND THESE LEAKY VALVES COST HIM BARRELS AND BARRELS OF PRODUCTION EVERY DAY . . . !

Maybe this guy knows that his valves "leak a little" . . . So what? . . . Let's take a look at the "So What." . . .

Leaking valves in an adsorption type plant permit mixing of the main stream and the regeneration gas; the regeneration stream is the carrier for ALL of the liquid product as it comes from the bed during regeneration. . . . So loss of this regeneration gas is a direct loss of product!

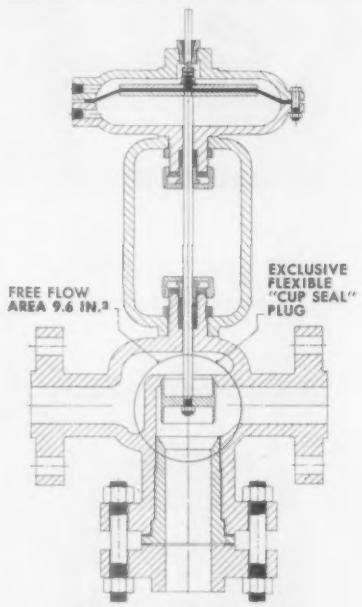
Where is it lost to . . . ? It escapes from the regeneration system back to the main stream, possibly at a point where it is taken into a bed that is adsorbing. . . . So it might appear that the product that leaked through a valve is "re-adsorbed" in another bed, and nothing is lost after all. . . .

To clarify this point, just suppose that ALL of the regeneration gas went back into the main stream; so instead of any production being condensed, the ENTIRE production from a bed was shuttled to another one that had the main flow passing through. The quantity of "shuttled" liquid is the same as that which would be adsorbed from the main stream during one cycle. . . . So we are trying to add a bucket of water to a bucket that is already full of water! The overflow can only go one place. . . . Down the gas line!

There is no excuse to tolerate such "overflow" losses of production due to valve leakage! PARQUIP valves for gas processing plants do not leak! These valves are different. . . . They are designed and built specifically for service in plants that demand zero leakage, extra large port area for minimum pressure drop, and trouble free operation.

This line of PARQUIP valves has port areas for free flow some 150% of the pipe area. . . . For normal temperature service, the valves have vulcanized synthetic rubber seating elements. . . . For high temperatures necessary in the regeneration gas circuit, the PARQUIP CUP-SEAL VALVE with the FLEXIBLE METAL TO METAL SEATING DESIGN IS THE ONLY VALVE MADE THAT WILL PROVIDE A POSITIVE TIGHT SHUT OFF!

PARQUIP has a complete line of simple valves and controls designed for field gas processing plants . . . Temperature . . . Pressure . . . Liquid Level . . . Interface . . . Flow Rate . . . Proven by four years of field service in all types of plants. . . .



P-4103F 3"—1500# valve

PARQUIP INC.

PARQUIP
OIL & GAS CONTROLS

P. O. BOX 7496
3030 MAX ROY STREET
HOUSTON 24, TEXAS
PHONE UNderwood 9-3658

Odessa • Liberal • Bakersfield • Lafayette

PIPELINE CONSTRUCTION

Bukhara, northward to Sverdlovsk and Chelyabinsk.
Status: Planned.
Project: From Tashkent to Chimkent, Dzhambul, Frunze and Alma-Ata near Chinese border.
Completion: By 1965.
Project: Line from Berezovo field southward to Sverdlovsk.
Status: Proposed.
Project: Line from Minsk northward to Baltic Sea area.
Completion: To Vilnius, Lithuania, in 1961; to Riga, Latvia, in 1962.
Project: Line from Minsk northeast to Leningrad.
Status: Proposed.
Project: 800-mile, 40-in. line from Krasnodar fields north of Caucasus Mountainsto Serpukhov, south of Moscow, via Rostov and Lugansk.
Status: Under way.
Project: 310 miles of 32-in. line ringing Moscow at radius of about 50 miles.
Status: Under way.
Completion: 1962.

YACIMIENTOS PETROLIFEROS FISCALES (Argentina), Buenos Aires.
Project: 1,050-mile line from Comodoro Rivadavia to Buenos Aires with a spur ta Plaza Huincul field in Neuquen Province. Line will be 26 in. to Plaza Huincul and 30 in. to Buenos Aires.
Status: Proposed.

Construction of New Dixie LPG Line Moves Along at Good Clip

PIPE laying on Dixie Pipe Line Co.'s 1,077-mile LPG system from Mont Belvieu, Tex., to Raleigh, N. C., is expected to be finished in December.

Each of the nine line-construction spreads is moving ahead about 1½ miles a day. Three other spreads are handling river crossings.

Ten pump stations, which will give the line an initial capacity of 65,000 bbl. of butane and propane per day, will be completed early next year.

Service Pipe Line Co., which designed the system, is supervising line construction. Phillips Petroleum Co. designed the terminals and will direct their construction.

Swampy, heavily-wooded terrain is making pipe laying a tough job. Some of the obstacles: 44 river and stream crossings, 66 railroad crossings, and 376 road crossings.

Contractors are using long pipe—averaging 58 ft. in length. This has caused some minor handling problems but has reduced welding.

Interstate Inspection, Inc., Central X-Ray, Inc., and Richardson X-Ray Service are handling weld-quality control.

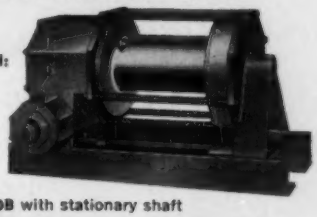
Koenig INTRODUCES A REVOLUTIONARY NEW TYPE OF HEAVY-DUTY POWER WINCH

FEATURING TORQUE TRANSMISSION DIRECT FROM GEAR SPIDER TO DRUM . . . NO KEYS TO SHEAR

20,000 pounds safe hoisting capacity

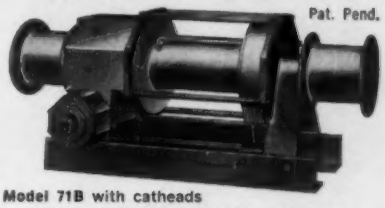
Outstanding features of the NEW KOENIG WINCH:

★ Drum torque load is NOT transmitted by drum shaft . . . no keys to shear . . . torque is transmitted direct from gear spider to drum by means of multiple-splined collar in gear housing.
★ Entire unit, including safety brake, is lubricated by the oil-bath principle, with a generous supply of oil to prevent overheating.
★ Engineered to use standard lubricants available throughout the world.
★ Multiple-plate automatic safety brake, running in oil with one-direction clutch, is easily adjusted or released.
★ Accurate drum clutch position indicator.
★ Gear ratio — 38:1.
★ Nickel-bronze alloy worm gear. Hardened and ground worm mounted on Timken roller bearings.



Model 70B with stationary shaft

Pat. Pend.



Model 71B with catheads

THIS ADVANCED-DESIGN KOENIG WINCH IS RECOMMENDED FOR OIL-FIELD EQUIPMENT, PUBLIC UTILITIES, HEAVY WRECKERS, CONSTRUCTION, AND OTHER HEAVY-DUTY JOBS.

Koenig winches have served the industry with dependable pull and hoisting power since 1934. Koenig also builds a complete line of utility and service bodies.

IRON WORKS, Inc.

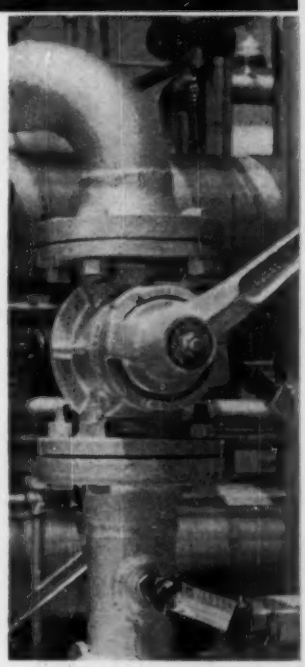
P. O. BOX 7726, DEPT. U • HOUSTON 7, TEXAS

This Valve's COST Keeps Going DOWN!

The minute you start using a DeZURIK ECCENTRIC-ACTION VALVE you STOP leakage losses. DeZurik's positive leakproof performance can and will save the valve's cost in a few months.

YOU SAVE MUCH MORE . . . the eccentric-action is friction-free. There's no rub, no scoring, virtually no maintenance, no adjustments. There's an absolute minimum of valve wear, a maximum of valve life. And there's no binding or freeze-up; eccentric-action opens and closes the valve with the easiest, smoothest quarter-turn, with accurate throttling, and without lubrication.

THE INITIAL COST of DeZurik Valves is low. Your own tests will show you that the cost GOES DOWN every day through savings on leakage, on maintenance, on extended life. WRITE FOR BULLETIN 110.

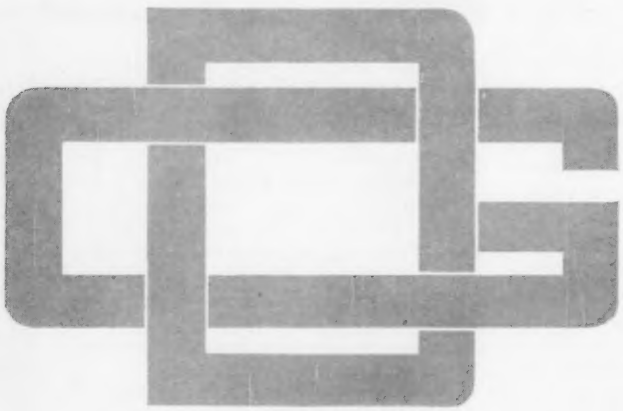


DeZURIK CORPORATION
SARTELL, MINNESOTA

GARDNER-DENVER 700 DRAWWORKS

Only Gardner-Denver, with its 100 years' experience in building every type of equipment for the oil field and industry, could have produced the completely new GD-700 drawworks. An eight speed, seven hundred horsepower unit, it is unparalleled in its depth class. The GD-700 design features short shafts that reduce bearing center distances . . . unit engineering of sprockets and chains to reduce wear . . . heavily reinforced side plates for rigid bearing support. Every component has been selected and engineered to produce a balanced drawworks that will operate with speed and low cost maintenance on drilling programs in the 5,000 to 10,000 foot range. □ The drawworks, transmission, controls, compound, engines and pump drives are mounted on a single main skid. When moving, only the auxiliary brake with its skid and the engines need be removed. Throughout the engineering of the GD-700, every drilling problem has been considered to assure the operator of a drawworks that is fast, safe and easy to move. □

The new Gardner-Denver 700 drawworks features: 330° wrap drum brakes □ Eight hoisting speeds and reverse □ Four rotary speeds and reverse □ Air controls for all rig operations □ All friction clutches mounted outboard □ Auxiliary positive Lo drum clutch □ Positive transmission clutches □ Centralized brake lube-center □ Hydromatic brake water level control at console □ Two package moving **GARDNER-DENVER**



© 1961 Gardner-Denver Company, Quincy, Illinois

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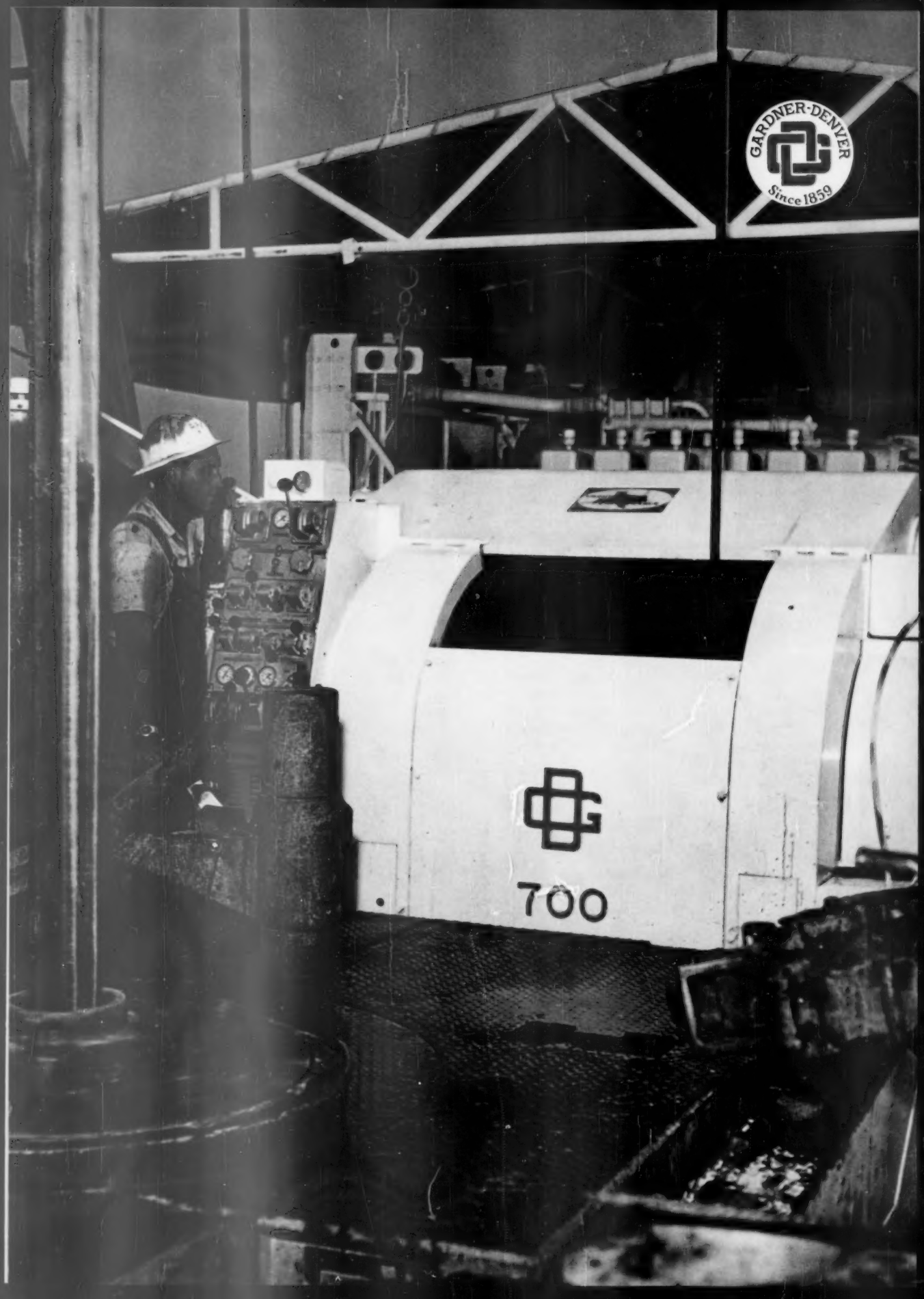

GARDNER·DENVER
Since 1859
700

The GD-700 is a single skidded drawworks with all components mounted in line on the main skid section except the hydromatic brake and the engines. On location only these two elements need be rigged up to be ready for spudding-in.

The drum clutches and chains are mounted outboard where they may be easily serviced and inspected. Drum and brakes can be checked or inspected by removing the full width front panel. A unique tilting arrangement allows the driller's console to drop forward exposing valves and piping.

Trim-True
TRAVELING BLOCK 200 TON

Turbo-Lubricated
SWIVEL 200 TON

Turbo-Lubricated
ROTARY 17 1/2"

Full line manufacturing from rotary table to mud pumps . . . Gardner-Denver drilling equipment has been designed as a matched team for greatest drilling efficiency. In addition to the drawworks, there is a swivel, block, rotary table, compressor and mud pump to match every drilling program.

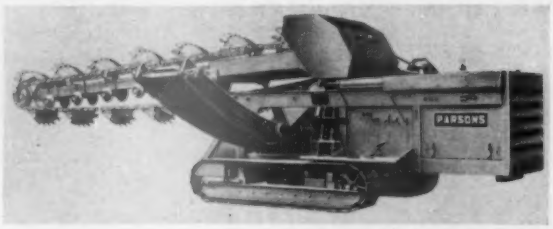
GARDNER-DENVER Since 1859 — 1 CENTURY

Gardner-Denver equipment combines imaginative engineering and modern technology with a century of experience.

GARDNER-DENVER

U. S. A. Gardner-Denver Company, Quincy, Illinois. Offices in principal U. S., Canadian and Mexican cities. Petroleum Products: Dallas, Texas. CANADA Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario. INTERNATIONAL Gardner-Denver International Division, 233 Broadway, New York 7, N. Y. Offices: Buenos Aires, Argentina; Artarmon, N. S. W., Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal.

What's NEW .. in equipment



Trencher Digs Wide and Deep

TRENCHES from 18 to 48 in. wide and up to 15 ft. deep can be dug with a new trencher now out. Measuring 9 ft. 2 in. high and 7 ft. 10 in. wide, the Model 255 trencher features hydraulic actuation of the steering and bucket-line clutches to permit fast response to depth variations and to hold close grade tolerances. Hydraulic power provides positive down crowd, easy set-ins, and finger-tip control.

Sixty digging feeds are available from 3.9 to 140.2 in. per minute. The crawlers have 16-in.-wide shoes which result in a bearing pressure of 7.8 psi. Source: **Parsons Co.,** P. O. Box 431, Newton, Iowa.

Air-Cooled Heat Exchanger

NO FIELD ASSEMBLY is required for this standardized-design air-cooled heat exchanger, according to the manufacturer. The M Series cooler is preerected and ready for hookup. It is designed for completely packaged shipment by truck.

The only field work required is to connect the piping and to tie in the electrical system. The unit can be used singly or coupled in parallel to handle large cooling problems. Source: **Smithco Engineering, Inc.,** Box 3217, Tulsa, Okla.

Reinforcement for enamel coatings

In the new reinforcement, glass fibers and yarns are pressed into a mat to form an inner wrap or reinforcement for enamel coating. A new binder applied to the fiber and yarn makes the product, called Coromat, flexible and easy to handle. The fibers are held tightly so they won't fly off the mat when it is applied under mechanical stress around a pipe.

When the reinforcement passes through the enamel coating, it lets air escape, helping prevent holidays. Source: **Owens - Corning Fiberglas Corp.,** National Bank Bldg., Toledo, Ohio.

Want more facts about equipment or copies of product literature described in this issue?

Send this coupon

to manufacturer at address shown after each item.

Product name, Model no., literature title or number: _____

_____

_____

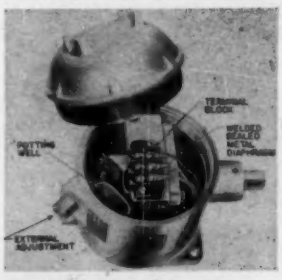
Described in OIL AND GAS JOURNAL-Issue of September 25, 1961

NAME _____ **TITLE** _____

COMPANY _____

ADDRESS _____

CITY _____ **STATE** _____



Explosionproof pressure switch

Both single-setting and dual-control models of this pressure switch are available. The housings have electric outlets, and integral terminal blocks are provided for wiring convenience. The diaphragm capsules are removable without interfering with the switch wiring and may be interchanged easily to accommodate varying pressure requirements or fluid characteristics.

In the low setting, the switches will actuate at 0.1 in. of mercury with a proof (test) pressure to 10 psi. In the higher ranges, they will go up to 300 psi. proof pressure at settings to 150 psi.

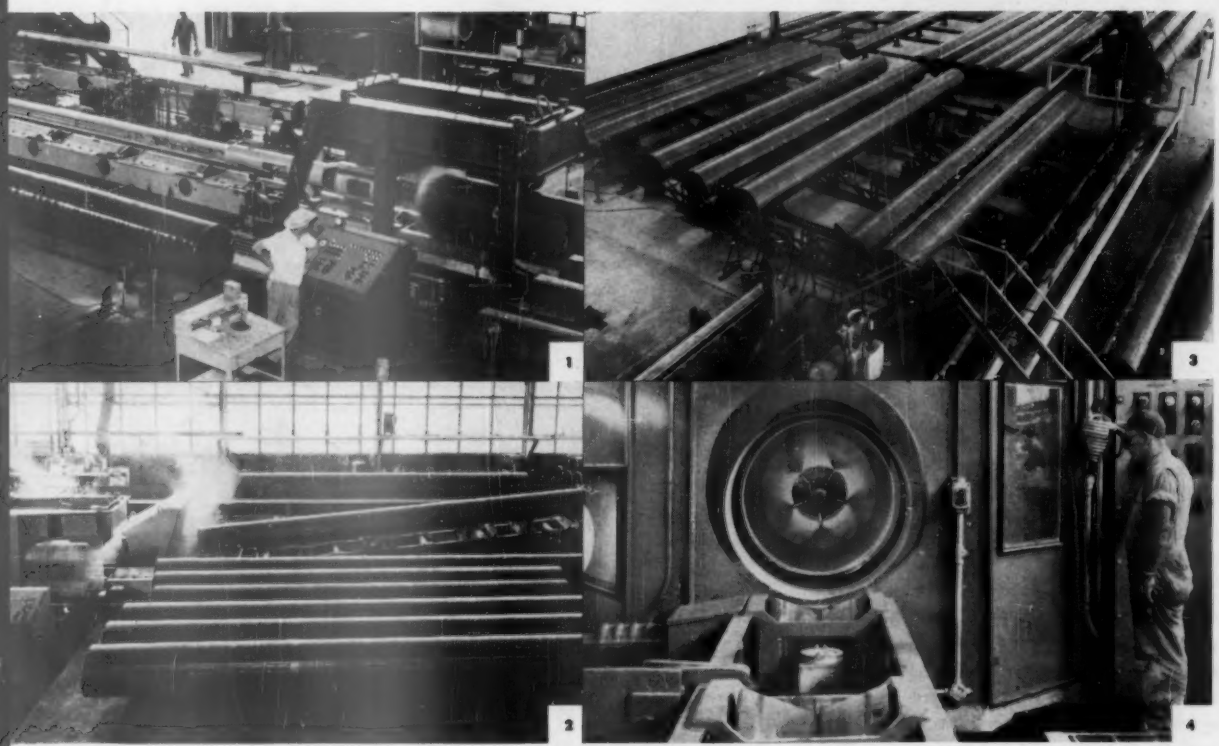
The standard pressure connection is a ¼-in. NPT female pipe fitting. Source: **Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.

INSIDE STORY — Production line coating permits direct operation and supervision by A. O. Smith personnel, maximum automation and quality control and the protection of the already pickled internal surface of the pipe from adverse weather conditions.

Pipe coating equipment of a completely new design all under one roof! At Houston as well as Milwaukee you can take advantage of internal coating of 16" through 36" line pipe to your specifications — the complete automated process takes place in fully enclosed buildings supervised by expert A. O. Smith personnel.

And as in Milwaukee, equipment and operations have been specially designed to give particular attention to the cleaning and preparation of the pipe surface prior to actual coating. This follows A. O. Smith's belief that the best coating results are obtained from an originally clean, pickled surface, and that coating applied to such a surface will yield maximum benefits to the user.

industry's most modern internal coating facilities at A.O.Smith Houston plant



ALL UNDER ONE ROOF

1 DOUBLE SCRUBBING — Pipe is brushed on both forward and reverse cycles. On the forward cycle the pipe is wire brushed with a hot detergent solution. On the reverse cycle a clear hot water spray is used.

2 HOT RINSING — Water heated to 180° is used for the wash out operation. Pipe is elevated to drain rinse water while heated air is blown through to speed drainage and drying.

3 CONVEYING AND DRYING — After completion of the hot rinsing and wash out operation, the pipe dries as it is slowly conveyed to a holding station just outside the coating area.

4 COATING — Airless spray equipment applies the coating within an 8'x8', dust-free steel enclosure. The entire coating area is separated from the rest of the mill by an "air curtain" created through pressure reduction.

Through research ... a better way

A.O.Smith
CORPORATION
TUBULAR PRODUCTS DIVISION
Milwaukee 1, Wisconsin

Chicago 4 • Dallas 35 • Houston 2 • Los Angeles 17 • Midland 5, Texas • New Orleans 12
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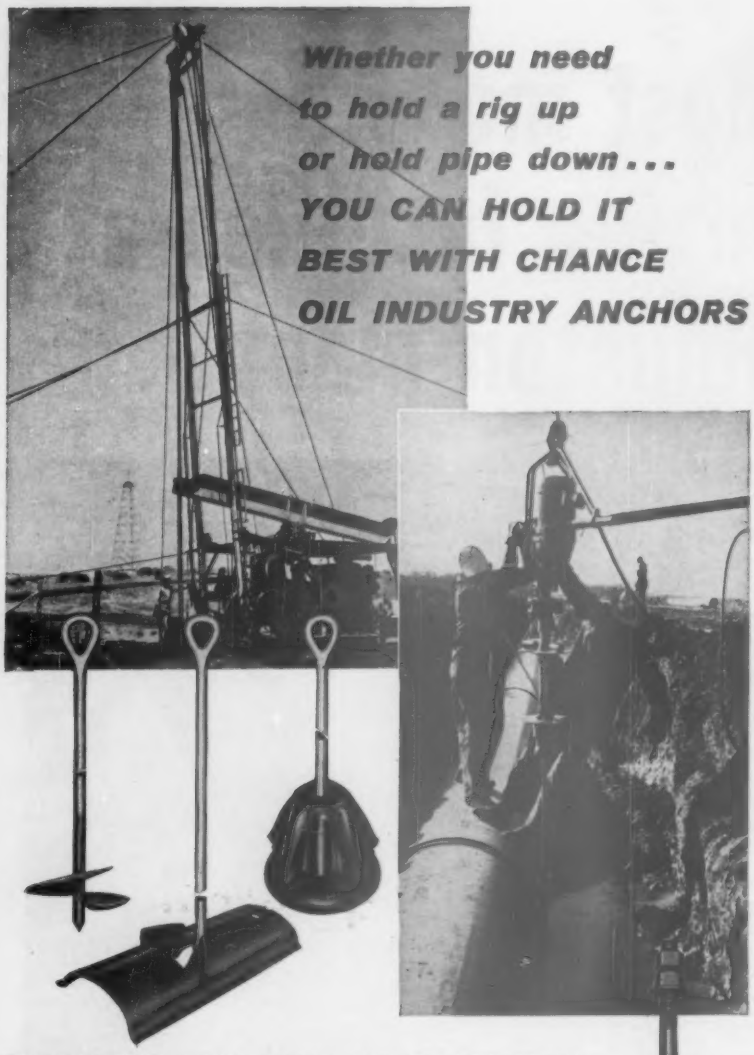

Whether you need to hold a rig up or hold pipe down . . . YOU CAN HOLD IT BEST WITH CHANCE OIL INDUSTRY ANCHORS

GUY YOUR DRILLING OR SERVICING EQUIPMENT with Chance Screw Anchors, Chance Expanding Anchors, or Chance Plate Anchors. Depending on soil conditions, and the load to be held, and whether the installation is to be temporary or permanent, one of the three is just right for any application.

SOLVE PIPELINE FLOTATION PROBLEMS with Chance Pipeline Screw Anchors and Tie-Down Brackets . . . the surest, easiest, and most reliable way to anchor pipelines. Your costs will drop about 85% compared to counter-weighting, and you can have the whole project engineered, supervised, and tested by Chance technicians under the Chance Field Service Plan. This cuts time and labor costs . . . makes certain the anchoring is adequate for every foot of pipeline. We'll also supply special installation equipment and the services of an installation supervisor for a reasonable fee.

C061-9

For complete information, contact: Petroleum Equipment Engineering and Service Division of

A. B. CHANCE COMPANY

1311 Polk Ave., Houston 2, Texas, Phone CApitol 8-2777

INTERNATIONAL DIVISION CENTRALIA, MO., U. S. A.

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B·I·F Industries

A DIVISION OF THE NEW YORK AIR BRAKE COMPANY

377 HARRIS AVENUE, PROVIDENCE 1, RHODE ISLAND

New insulated water can

Liquids can be kept hot or cold for a long time with a new water can, called the Gotkool, which is made of galvanized steel, lined with polyethylene, and insulated with urethane foam. Available in four sizes, 2, 3, 5, and 10 gal., it is expected to be welcomed by field crews and equipment operators as it is designed to keep liquids at the desired temperature for long periods. It withstands temperatures from −150° up to 210° F.

Features include a seamless lid and liner formed from rigid polyethylene. It has a nylon faucet that is flush-mounted and will not transmit heat into the cooler, the maker says. Source: **Gott Mfg. Co.**, P. O. Box 702, Winfield, Kans.

•

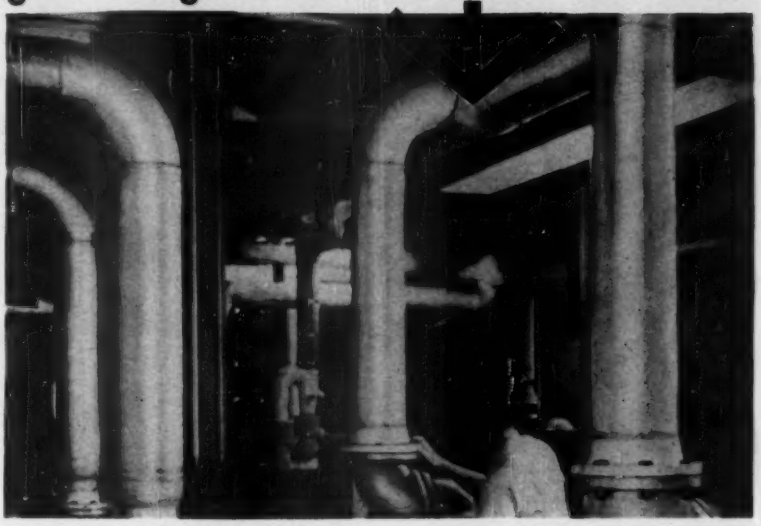
Engine-unbalance indicator

Unbalance in engines and other rotating machinery can be analyzed readily with a new pulse-synchronized unbalance indicator, called PSUI. The instrument is portable, compact, and lightweight. It measures 9 by 14 by 20 in. and weighs 40 lb.

Filtering is done by synchronous rectification circuits that reject noise through an operating range of 500 to 5,000 r.p.m. on the standard instrument, or up to 50,000 r.p.m. on a special instrument. The synchronizing pulses are obtained from the rotating part itself by means of a

from ALCOA

good designs made better with aluminum



All-aluminum cooling system reduces danger of water contamination in Brookhaven's new Synchrotron

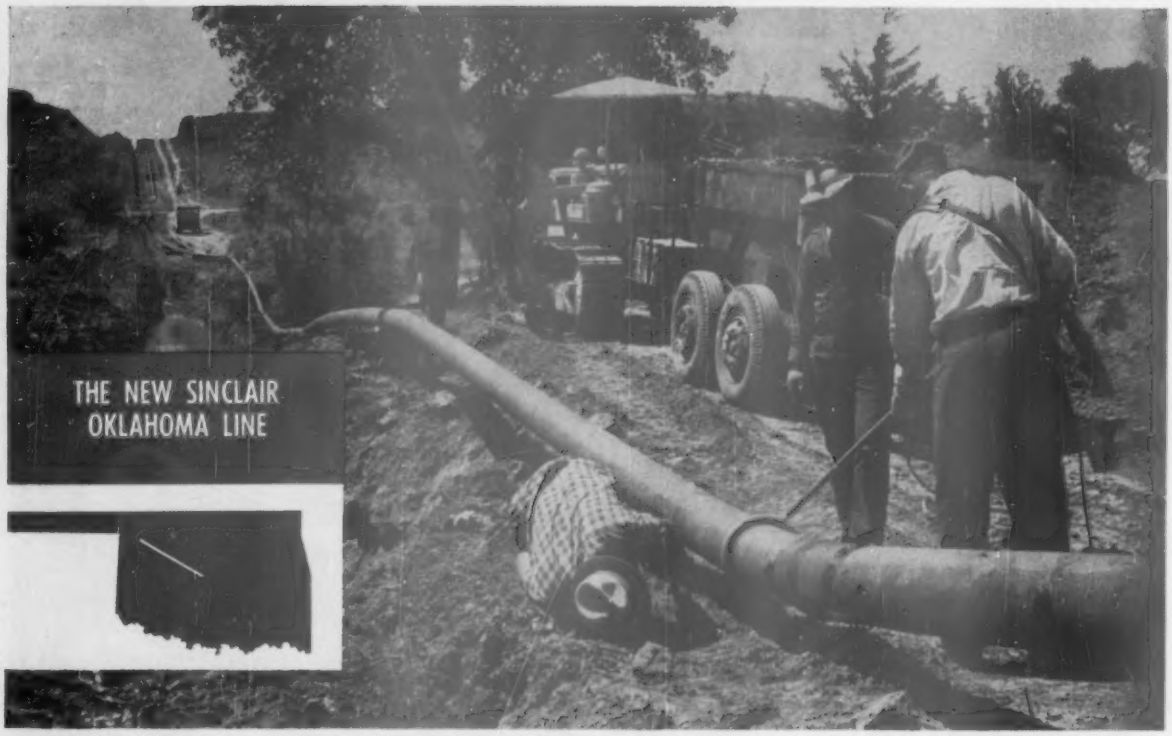
More than one mile of aluminum piping and some 2,600 FLOWLINE aluminum fittings comprise the magnet cooling system at Brookhaven National Laboratory's new Alternating Gradient Synchrotron. High-purity water at 65°F is circulated through an aluminum piping system to cool electromagnets arranged in a one-half mile long circular ring; the water is then returned to heat exchangers. Because the conductivity of the water must be kept below 11 micromhos, aluminum was selected for its superior resistance to corrosion. View of pump room above shows sections of aluminum piping; FLOWLINE tees, elbows, and reducers, made with ALCOA® Aluminum by Flowline Corp., New Castle, Pa. For more information about aluminum's applications and versatility, please send the coupon.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 826-J Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries:

- ☐ 34-10197 Aluminum Pipe and Fittings
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 68-10460 Process Industries Applications of Alcoa Aluminum
- ☐ 88-11453 Solving Refinery Corrosion Problems with Aluminum

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____



SINCLAIR SPECIFIES ALLIED PIPELINE ENAMELS

Allied Standard Coal Tar Enamel was specified for Sinclair Pipe Line's new 8-inch crude oil line, stretching 178 miles from north of Oklahoma City to Woodward, Oklahoma.

Running this light wall 8⅝ inch coated pipe through Western Oklahoma's rough terrain meant sharp bends in some places. Allied Standard Coal Tar Enamel withstood these bends. This assures the company, the contractor, and the applicator that these enamels will *remain firmly bonded* to the pipe, even under the toughest conditions.

Trucks from the Allied Stroud, Oklahoma plant delivered the Allied Standard Enamel to Pipe Coating of Tulsa's two yard coating operations at Woodward and Oklahoma City. Each yard handled an 86-mile section of the line.

Project engineer for Sinclair Pipe Line was D. S. Kauffman. Pipeline contractors were: R. H. Fulton Construction Co. of Lubbock, Texas. Oscar Phillips, superintendent for the Woodward section of the line. And, Brodie Construction Co. of Amarillo, Texas. C. C. Corrigan, superintendent for the Oklahoma City section. Coating was done by Pipe Coating of Tulsa, Gaines Laster and Ivan Brunkow, owners.

For more information on the advantages of Allied Pipeline Enamels, write:

ALLIED MATERIALS CORPORATION

Producers, Refiners and Compounders of Special Asphalt and Coal Tar Products
Pipeline Materials Division, Mel Maddox, Manager

Allied Building • 5101 N. Pennsylvania • P. O. Box 7278—39th Street Station • Oklahoma City, Okla.
PLANTS: Stroud, Oklahoma • Detroit, Mich. • Los Angeles, Calif.

Allied Pipeline Enamels come from 29 years experience in the compounding of special coal tar and asphalt products.

ALLIED PIPELINE ENAMELS—COAL TAR BASE: **Allied Standard Pipeline Enamel • Allied Intermediate Pipeline Enamel • Allied Plasticized Pipeline Enamel • Allied Waterworks AWWA Enamel • Allied Special Enamel 250+.** COAL TAR PRIMERS: **Allied Coal Tar Primers • Allied Waterworks AWWA Primer • Allied Quick Dry Primer.** ASPHALT BASE: **Allied Pipeline Enamel** • ASPHALT PRIMER: **Allied Pipeline Primer.** COLD COATINGS: **Allied (Coal Tar) CA 50 • Allied (Coal Tar) CA 5.**

magnetic, photocell, or capacitive pick-up. A 10-mv. peak-to-peak input signal from the vibration pickup produces a full-scale deflection. Source: **General Motors Research Laboratories,** 12 Mile and Mound Rds., Warren, Mich.

•

Portable two-way radiophone

The fully transistorized receivers in a new line of portable two-way radiophones are claimed to double battery life and cut operating costs in half as compared to nontransistorized units. Rechargeable nickel-cadmium batteries provide 8 hours' operation per charge.

Models available in the radio line include single and two-frequency units, and compact microphone and telephone style handsets. Power output ranges from 1 to 8 watts. The Handie-Talkie radiophone with lightweight pack weighs less than 8 lb. Source: **Motorola Inc.,** 4501 W. Augusta Blvd., Chicago 51, Ill.

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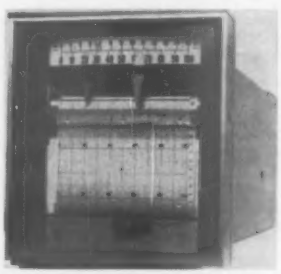
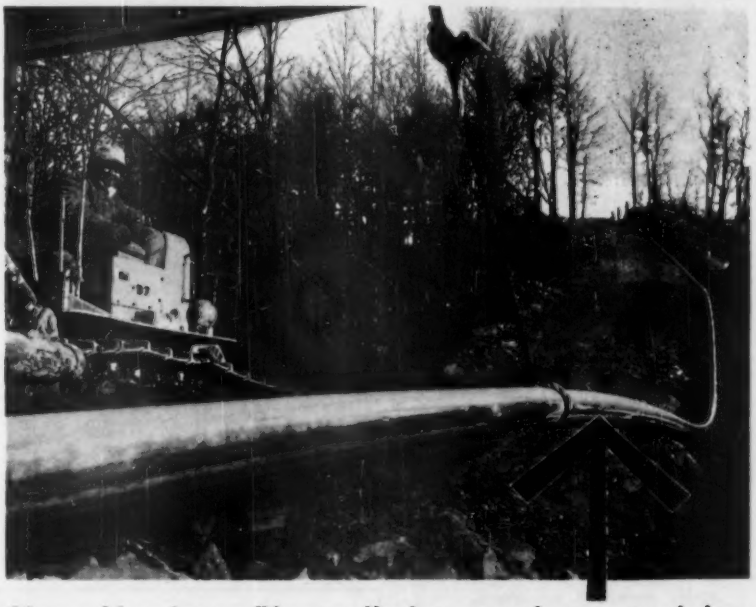


Miniature pneumatic instruments

Simplified startup and operation of industrial processes is promised by a new line of pneumatic instrumentation, called PneumatiK Tel-O-Set. The line consists of 4-in. indicating, recording, and controlling devices which are said to make possible manual-automatic control transfer without the complicated procedure of matching pressures.

from ALCOA

good designs made better with aluminum



Alcoa Aluminum Pipe pulled across two mountains to connect United Fuel Gas Company wells

Using a fast weld-and-pull method, H. B. Ranier Construction Co., Prestonsburg, Ky., recently laid 5,800 ft of Alcoa* Unistrength Pipe in record time. The permanent, underground installation connects remote UFG wells in rugged eastern Kentucky. Ranier pulled the line up, over and down two mountains—past stationary welding stations. Unistrength's light weight (96 lb per 40-ft length compared to 480 lb for steel) and ability to conform to the terrain made the job seem almost easy. Developed especially for pipelines, Alcoa Unistrength Pipe is a seamless, one-piece product, with schedule wall thickness at the ends and unnecessary metal removed along the length. This provides uniform strength after welding—reduced weight 30 per cent over conventional aluminum pipe. Please send coupon for more information.

*Trademarks of Aluminum Company of America

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 826-JJ Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature:

☐ 34-11346 *New Alcoa Unistrength Pipe*

☐ 34-21113 *Hill Top Pipeline Installation Tests New Pipe-Laying Techniques*

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Company_____

Address_____

City_____ Zone_____ State_____

TEX-Steamer

THE COMPACT
PACKAGED AUTOMATIC
STEAM GENERATOR

HERE'S compact power in the palm of your hand! A complete package, easily mounted on truck, trailer or skids for mobile use, generating steam on demand in just three minutes from a cold start.

COMPARED to larger, bulkier generators of similar capacities, the TEX-Steamer is a lightweight example of modern engineering efficiency. Units shipped complete with controls, electric motor or gasoline engine prime mover and fittings installed and tested at the plant.

TEX-STEAMERS available in 10, 20, 40, 65, 125 HP models from 75 to 600 lbs. pressure. 325 to 3450 lbs. steam per hour from and at 212 F. Write for catalogue with complete details.

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6104

Cascade control, resetting of a set point of a primary controller by a secondary controller, is said to be both practical and convenient for the operator. Design features of the instrumentation provide for zero and damping adjustments to be made without removal of the recording-chart drive mechanism, continuation of process control on automatic or manual control when the recording or indicating chassis is removed, and true reset bypass, such that on switching to manual control, valve-loading pressure goes directly to the reset chamber and not through the reset needle valve. Source: **Brown Instruments Div., Minneapolis - Honeywell Regulator Co.,** Wayne & Windrim Aves., Philadelphia 44, Pa.

●

Fresh water from brackish wells

A new distilling unit has been developed which is claimed to solve the problem of scaling and corrosion on heat-transfer surfaces that has heretofore accompanied the evaporation of sea water. The unit is said to make it possible to boil sea-water at an unusually low temperature of about 107° F., compared to a usual boiling point of 212° F. at sea level.

At the lower boiling temperature, the corrosive action of sea or brackish water is only about one-eighth of that experienced at the usual boiling temperature. Presently available units will produce 10,000 gal. of pure fresh water a day from either the sea or from brackish wells, the maker says. Source: **Mechanical Equipment Co.,** 861 Carondelet, New Orleans, La.

●

Seismic recording system redesigned

Three major components of the portable TFA field seismic recording system, the control panel, camera, and tape transport, have been redesigned to entend the capabilities, simplify maintenance, and fit their functions into more compact packages. The fully transistorized TFA system is said to offer field crews in remote areas the option of

MACCO
PRODUCTION COMPANY

MACCO PARAFFIN SCRAPER—SUBSURFACE PLUNGER
(Lubricator and Plunger)

The Macco Paraffin Scraper is used primarily for removing paraffin deposits inside the tubing string. It has also proven highly successful for unloading sluggish gas wells, flowing wells which are produced by the "stop-cock" method, and as a plunger for lifting fluid in high ratio oil wells.

The lubricator and catch assembly is mounted on the wellhead with the plunger inside. The plunger is dropped through the tubing to a predetermined tubing stop.

The timing of this operation is regulated by a flow line controller, except on intermitting gas lift wells. When the well kicks, the plunger returns to the surface, removing paraffin deposits.

If your well falls under one or more of these basic type wells, check with your Macco representative for further information: or write for Paraffin Scraper Brochure No. 14-02.

- PARAFFIN PRODUCTION
- HIGH GAS-OIL RATIO WELLS
- GAS WELLS THAT LOG UP
- HIGH GRAVITY GAS LIFT WELLS
- STOP-COCK WORK ON LOW PRODUCTION WELLS
- EMULSIFIED FLUID PRODUCTION

MACCO equipment is also available in sterling areas from Williams & James (Oil Tools) Ltd., Gloucester, England.

MACCO OIL TOOL COMPANY, INC.
1521 Prince P. O. Box 7288 Houston 8, Texas Phone UN 1-1253

producing playbacks on portable instruments that will be equivalent to those obtainable through regular truck-mounted equipment.

The equipment features modular plug-in construction which makes servicing of the system easier in the field. The system needs only one 12-volt battery for power.

The case now houses 24-trace tape matching transformers and 24-trace tape-data playback amplifiers in addition to the previous elements. The unit weighs 39 lb., mounted in the case. Without the playback assemblies, it weighs 25 lb. Source: **Western Geophysical Co.**, 933 North La Brea Ave., Los Angeles 38, Calif.

●

Microwave for 6-8, 11-15 kmc.

This new series of microwave transmitters and receivers for the 6-to-8 and the 11-to-15-kmc. frequency ranges provides transmitter outputs of 100 mw. and 1 watt in the 6-to-8-kmc. range and 50 to 500 mw. in the 11-to-25-kmc. range.

They are expected to be particularly applicable for wide-band data-transmission, high-density communication systems. The receiver has a base-band frequency response of ±0.5 db. from 50 c.p.s. to 8 mc. Source: **Collins Radio Co.**, Box 1891, Dallas 21, Tex.

●

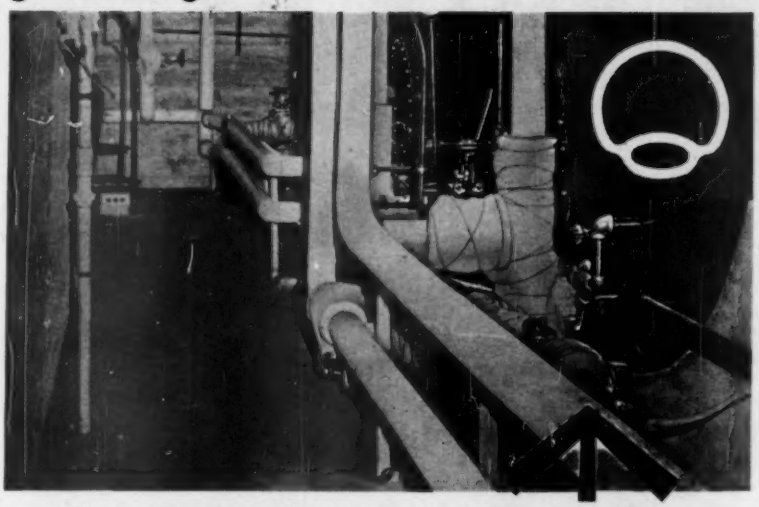
Resonator extends radio range

A range and sensitivity extending resonator, called the Raser, has been developed which is claimed to improve the distance covered by transistorized two-way radio sets in cars up to 43% over their present capability and to provide clearer, sharper, and more distinct messages.

The device will be added to all of the maker's high-band transistorized Progress Line mobile radios shipped after the early part of September. Source: **General Electric Co., Communications Products Dept., Lynchburg, Va.**

from ALCOA

good designs made better with aluminum



Globe Engineering installed Alcoa Unitrace system for piping paraffin and stearic acid . . . lowered fire hazard, increased production rate

Binney & Smith Inc., Winfield, Kansas, CRAYOLA® crayon manufacturer, recently effected cost savings with Alcoa* Unitrace piping, at one-eighth the quoted cost of stainless. Formerly, block paraffin had been melted slowly in holding pots. Now, Binney & Smith buys paraffin by tank carload, heats and pumps directly to underground storage. Stearic acid is also handled in the same system without discoloration. Fabricated and installed by Globe Engineering Co., Wichita, Kansas, the Unitrace system effected savings in purchasing, insurance, handling and production. Alcoa Unitrace is the light, strong, corrosion-resistant pipe that provides steam and product passages in a single extruded unit —eliminating costly external steam jackets or inefficient tracer tubes. Please send coupon for more information.

*Registered trademark of Aluminum Company of America

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☐ 34-10197 *Aluminum Pipe and Fittings*
☐ 34-10418 *Alcoa Unitrace: Combines Piping and Tracing in One Unit*
☐ DD- 514 *Alcoa Duotrace Technical Report*
☐ 68-10460 *Process Industries Applications of Alcoa Aluminum*

Name_____ Title_____
Company_____
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City_____ Zone_____ State_____

Special report to users of Caterpillar equipment:

CAT CATERPILLAR

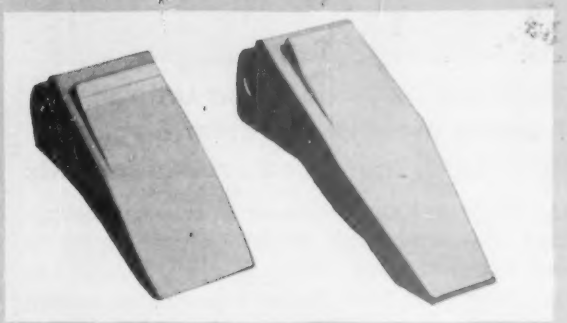
Parts you can trust
...cost less per hour

New Cat No. 8 and No. 9 Ripper Tips outproduce other brands 25 to 50% in field tests

That's the kind of news you can use—to cut costs. This newcomer to the Caterpillar line of ground-engaging tools is making a name for itself with cost-conscious users.

They're exceptionally wear-resistant—hardened to Rockwell C50 for longer wear-life under any conditions.

Check the price! Improved Cat Tips sell for about the same *or even less* than other leading brands.



They're available in two new designs. Both the short and long tips shown in the photograph are *self-sharpening* to keep their working edge until replacement. The long tip gives extra wear-life with only a slight reduction in impact strength. Low-cost, weld-on shank adapters are available for *all brands* of shanks. No need to wait—you can put these new Cat Tips on your job immediately.

In field tests the short tip was pitted against two leading brands on rippers working in caliche and cemented conglomerate beds. The Cat Tip outproduced the other brands 25-50%—representing savings of 38-54% in replacement costs.

Outstanding impact strength! One No. 9 Tip, tested in *solid* granite, took 13 smashing blows from another D9 pusher that backed up 10 feet before each charge at the stalled D9 Ripper.

And here's another money-saving newcomer—Cat's new No. 7, No. 8, No. 9 End Bits are redesigned for better digging ability. They self-sharpen as they wear away for continuing like-new performance. They're forged alloy steel and heat treated for outstanding strength and wear-resistance.

Compare other ground-engaging tool brands against the Caterpillar line. Keep machine-hour records and find out for yourself which is the best buy. Those who do, buy Caterpillar.

See your Caterpillar Dealer for the best in parts and service.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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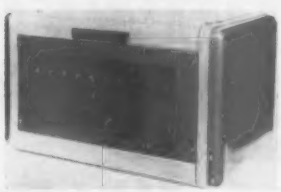
Diesel Engines • Tractors • Motor Graders • Earthmoving Equipment



Simplified supervisory system

This supervisory system, called Unicode, is designed to handle the control and indication of a single device at a remote station. At a remote station, the system will close and trip one device, such as a circuit breaker or motor contactor, while at the master station it continuously indicates with a lamp whether the device is open or closed and sounds an alarm when the position changes.

Up to 10 remote stations can be controlled from one master-station unit over a pair of wire lines. The system is intended for use where the master station and all remote stations are located within a relatively small area so that the loop resistance of the line-wire channel is low. Source: **Westinghouse Electric Corp.,** Box 2099, Pittsburgh 30, Pa.

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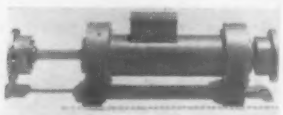

Meter tells shaft horsepower

The horsepower transmitted by a rotating shaft is measured directly with a new meter now on the market. A transducer sensitive to the product of speed and torque is coupled directly between a driving machine and its load. It produces a 0 to 20-volt d.c. output signal proportional to horsepower output.

The basic model is rated at 600 hp. Others are available with ratings from 50 to several thousand horsepower over wide speed and torque ranges, with an accuracy of 1%. Designed for outdoor use, the system uses no slip rings. It is capable of overload to three times normal rated torque. Source: **Waugh Engineering Div., Foxboro Co.,** 7740 Lemona Ave., Van Nuys, Calif.

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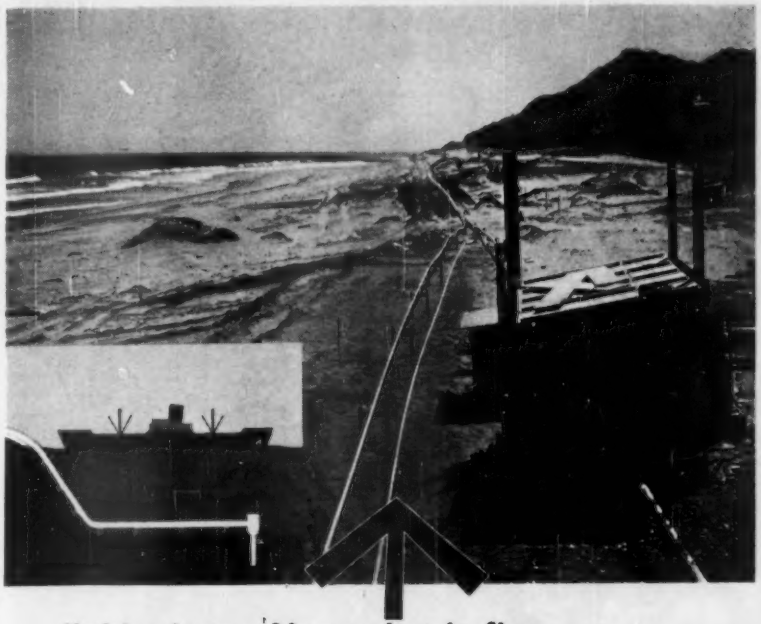

light, strong Alcoa pipe is flow system for first underwater completion well

Peruvian Pacific Petroleum Co. recently made history on several counts with the world's first underwater oil well completion. The flow system (3-in. flow line and ½-in. hydraulic valve control line) is Schedule 40 ALCOA® Aluminum Pipe. Specially fabricated 50-ft sections were welded into continuous lengths and launched through heavy surf and strong currents. During launching, the lines deflected hundreds of feet without rupture. Aluminum provides the flexibility and corrosion resistance for all types of pipelining. No need for costly coatings or wrappings to resist the ravages of marine corrosion. For more information about ALCOA pipe, please send the coupon.

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ALUMINUM COMPANY OF AMERICA

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Please send me the following literature covering Alcoa Aluminum for tubular products and other uses in the process industries.

- ☐ 34-10197 *Aluminum Pipe and Fittings*
- ☐ 34-11346 *Alcoa Unistrength Pipe*
- ☐ 34-21113 *Hill Top Pipeline Installation Tests New Pipe-Laying Techniques*
- ☐ 89-21203 *First Underwater Well Completion Made*

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Company_____

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"The Bank" is Toronto-Dominion

Oil interests in the United States wanting to do business north of the border find a "well" of sound information and guidance when they go to the bank that *knows* Canadian business.

For a Free up-to-date detailed map of the Western Canadian oil and natural gas fields and pipelines, PLUS a brochure entitled "The Canadian Petroleum Industry—Achievements and Prospects," write

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Oil and Gas Department,
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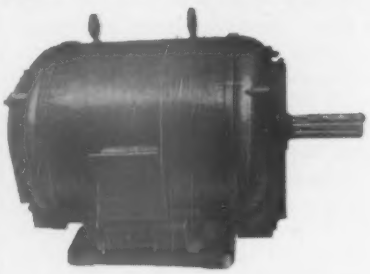

Available in SEMI and TOTALLY enclosed models, with special high temperature Class "B" or better insulation in **all critical** parts, and with Stators double dipped with Class "F" **special** insulating varnish which provides an **especially effective resistant** to heat, aging and moisture.

Yes, you will find FIELDMASTER MOTORS unusually efficient in overcoming **all** adverse conditions because they are

- **MOISTURE PROOFED**
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BETHLEHEM STEEL CO.
SUPPLY DIVISION
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What's New

. . . in literature

Flowsheet instrumentation symbols

Listed are symbols used by instrument and process engineers in drawing process flow sheets and schematic control systems. Bulletin 91-53G-02 includes symbols for process piping and lines, solenoids and other valves, measuring elements, and miscellaneous process equipment. In most respects, the symbols follow the recommended practice outlined by the Instrument Society of America. Source: **Fischer & Porter Co.,** 946 Jacksonville Rd., Warminster, Pa.

Supervisory control system

This new bulletin illustrates and describes a supervisory control system for oil and gas production and pipeline remote operation. The RCA 130 ALERT system is said to remove distance limitations from data gathering and supervisory control with complete security. According to the publication, the system is designed to maintain a constant watch over widely separated oil or gas wells or crosscountry pipelines, reporting breakdowns, relaying instructions from a central control point, and logging production data. Source: **Electronic Data Processing Div., Radio Corp. America,** 21 Strathmore Rd., Natick, Mass.

Pump fundamentals

This 16-page booklet gives you an elementary outline of the characteristics, operation, and selection of reciprocating, rotary, and centrifugal pumps. Nontechnical, it should prove of primary interest to all who desire a basic knowledge of pumps. Emphasis is placed on centrifugal pumps because of wide usage of this type. Definitions, basic formulas, examples, and miscellaneous data frequently used in pump application are included. Source: **Goulds Pumps, Inc.,** 226 Black Brook Rd., Seneca Falls, N.Y.

Intake snubbers

Just off the press is two-page Bulletin 279 featuring information and specifications on the BMI intake snubber to be used with positive-displacement blowers, reciprocating compressors, and gas and diesel engines. Included is a cutaway drawing, schematics, and a dimensional chart. Source: **Industrial Silencer Div., Burgess Manning Co.,** 9207 Sovereign Row, Dallas 7, Tex.

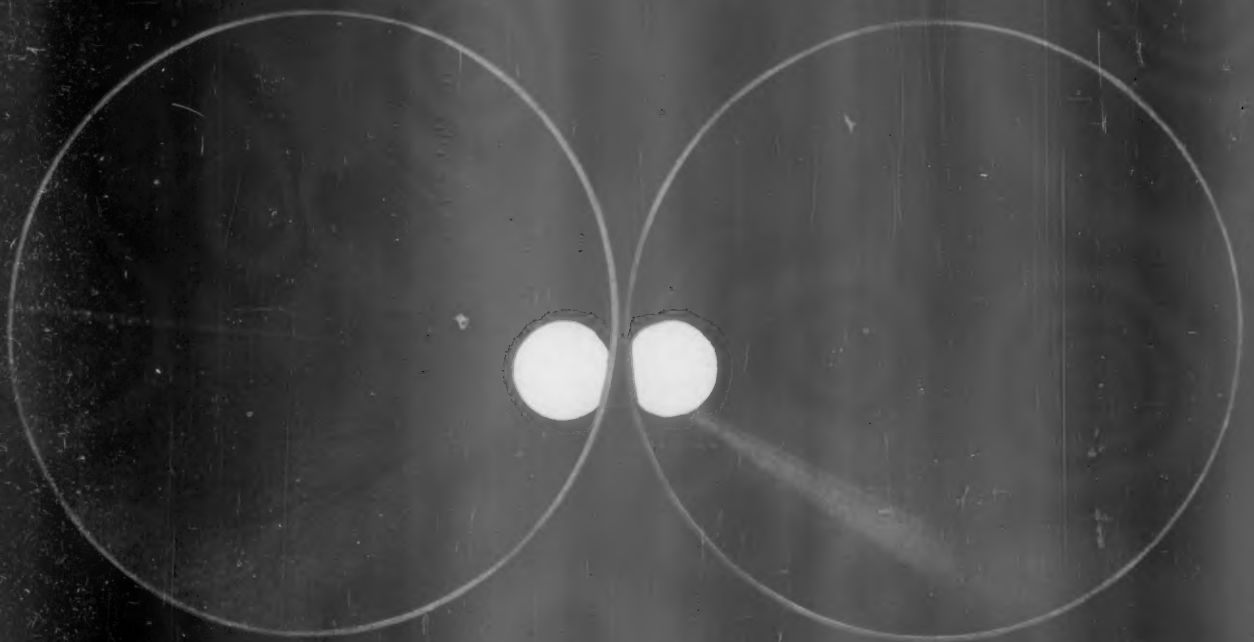
Folder on plastic pipe

Described in this six-page publication are numerous applications of plastic pipe for use in the oil industry. These include salt-water disposal, crude-oil flow lines, secondary-recovery operations, water-supply lines, gas-gathering systems, natural-gas transmission, and electrical conduit. Illustrations show plastic pipe in typical low-pressure water-flood operation and in a typical salt - water - disposal system. Source: **Southwestern Plastic Pipe Co.,** Box 117, Mineral Wells, Tex.

Engine "power digest"

Just issued, Bulletin 1151 (four pages) reviews 26 models of six

HELPING
1400 MILES
OF GAS
ON IT'S WAY
Keeping 1,400 miles of natural gas constantly on the move is quite a job. As a Canadian firm we are proud to have been given the opportunity of helping make this feat possible in the case of the $338 million pipeline which will shortly be bringing Alberta gas to the San Francisco area. The contracts recently awarded to us on this project—construction of a 15,000 H.P. compressor station at Crowsnest Pass, B.C., and the metering station on the Canadian-U. S. border at Kingsgate, B.C.—is a further tribute to the role our organization plays in the building of so many major Western enterprises.
MARWELL CONSTRUCTION CO. LTD.
1500 West Georgia Street
Vancouver, B.C. • Canada



At the right above is one section of a 30" line pipe internally coated with Napko's Epoxycote Pipeliner, the first amine-cured epoxy resin specifically formulated for gas line transmission. Epoxycote Pipeliner has now been used in all parts of the country with equally good results, providing a surface smoothness that increases line-flow efficiency and reduces maintenance costs. The uncoated section at the left shows severe pitting that can occur during transit and storage and that can be prevented by Epoxycote Pipeliner.

6% INCREASE IN PIPELINE FLOW EFFICIENCY WITH NAPKO EPOXYCOTE PIPELINER!

Extra Thru-Put and Cleaner Gas at Lower Maintenance Cost

Throughout the United States pipeline engineers report that lines internally coated with Napko's Epoxycote Pipeliner show record improvement in thru-put, product purity, and line maintenance economy.

Studies indicate that the walls of coated pipe have an average relative roughness of 280 micro-inches, compared to an average of 700 micro-inches in unweathered mill pipe. Weathered pipe in a mild environment in as little as 60 days can attain a surface roughness up to 1500 micro-inches (an additional 2-5% loss in efficiency).

Leading internal coating specialists such as L. C. Russell Company, Rosson Richards Company, H. C. Price Company and Stanley-Bledsoe Corporation testify to the dependable behavior of Epoxycote in both application and finished film properties.

For complete details and published project references write to

TESTED FEATURES OF EPOXYCOTE PIPELINER

PREVENTS PITTING IN TRANSIT & STORAGE: In industrial atmospheres, humid regions, and particularly marine areas, severe pitting can occur in uncoated pipe. Epoxycote moisture and chemical resistance virtually puts an end to pitting.

REDUCED CLEAN-UP EXPENSE: Pigging a new line to remove loose rust and millscale can cost up to 17¢ a foot, but after cleaning and lining with Epoxycote, a single plug is usually sufficient. Napko Epoxycote has maximum hardness to help prevent pigging damage.

CLEANER LINES & GAS: All rust and loose millscale can not be removed from uncoated pipe by pigging. Prior lining with Epoxycote minimizes load on scrubbers, with the cleaner gas ultimately reducing service of consumer gas appliances by the gas distributing company.

INCREASED CAPACITY: Friction losses are reduced by smoother internal surface.

PREVENTS INTERNAL CORROSION: Minute traces of moisture, oxygen, and such contaminants as hydrogen sulfide, accelerate pitting of uncoated pipe. Epoxycote Pipeliner is chemically resistant to the corrosive impurities of natural gas, insuring maximum protection of the line and the product.

NAPKO CORPORATION

INDUSTRIAL COATINGS DIVISION

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basic engines which span a range of 190 to 2,150 b.hp., with a choice of six or eight cylinders, naturally aspirated or supercharged, for low or medium speeds. Six of the 26 models are for gas operation, while the others may be run on diesel fuel, dual-fuel, or gas. A brief description and specifications of each engine are supplemented by references to other pieces of literature giving more comprehensive coverage of individual models. Source: **White Diesel Engine Div., White Motor Co.,** 1401 Sheridan Ave., Springfield, Ohio.

Glass-fiber-reinforced pipe

Three new pieces of descriptive literature about Fibercast pipe have just been published. A centrifugally cast, thermoset epoxy resin, glass-fiber-reinforced pipe, Fibercast was developed to handle special pressure and corrosion problems. The first publication describes the product, its industry applications, and its physical properties. The second piece of literature outlines the pipe in structural use, such as communications towers, and gives its weight, strength, and dielectric qualities. The third bulletin provides technical and specification data in detail. It includes tables setting forth chemical resistance data, specifications for chemical and oil-field pipe and down hole well tubing, and charts relating to line pipe and tubing. Source: **Fibercast Co.,** Box 727, Sand Springs (Tulsa), Okla.

Compression and power

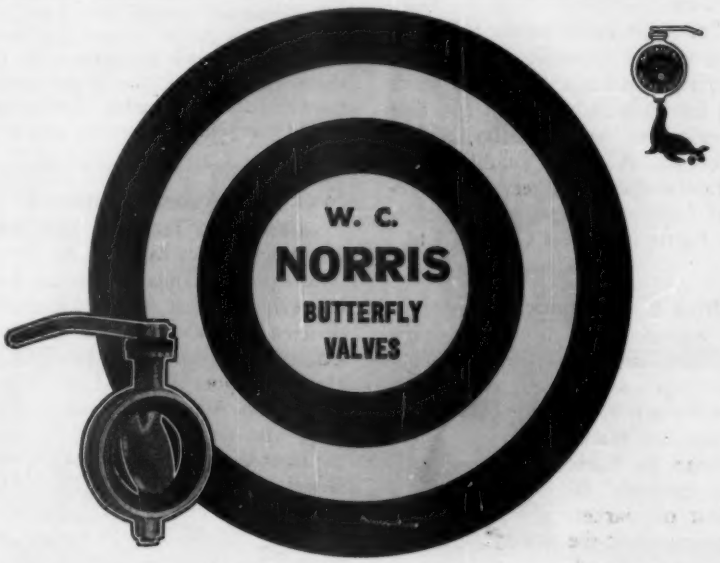
This obtainable 12-page publication features a complete lineup of engine and motor-driven compressors, power engines expansion engines, industrial jet-powered gas turbines. and En-Tronic control systems. These products have applications in gas transmission, power plants, gas-field gathering, petrochemical processing, and laboratories. Source: **Cooper-Bessemer Corp.,** Box 751, Mount Vernon, Ohio.

Triple-completion-tubing

This 58-page brochure promises to solve problems in the engineering of triple-completion wells—determining the diameters of three tubing strings to fit into a particular-size casing. Sun Oil Co. developed the formula for computations that are helping in the selection of appropriate-size tubing and casing when planning tubular programs for triple-completed wells, and W-K-M worked with the Texas A&M Research Center in setting up the tabulations. In all, 4,913 tabulations were run on the college's data-processing equipment. They are applicable to triple completions of new wells and to recompletion of old wells at new producing levels. The tables, which are based on the above-mentioned formula, provide a quick reference to determine the many possible tubing and casing combinations involved in triple completions. Source: **W-K-M Div., ACF Industries, Inc.,** Box 2117, Houston 1, Tex.

Used-equipment list

A pocket guide to "bargains" has been made available in a 16-page form. It lists used equipment ranging from complete drilling rigs to pumps, rotary tables, pumping units, engines, and rubber V-belts. Source: **Jones & Laughlin Supply Div.,** Drawer 2481, Tulsa 2, Okla.



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BRANCHES: Great Bend, Houston, Kilgore, Odessa, Wichita Falls, Salem, Casper, Farmington

Equipment Men Notes

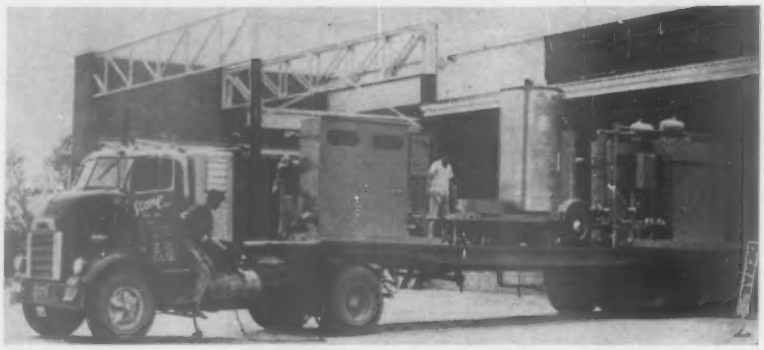
Lee P. Stillman is vice president of Farris Engineering Corp.

Before accepting this new appointment at Farris, Stillman served 22 years with Manning, Maxwell & Moore where he held successive positions as sales engineer, product manager, works manager, and manager of the Tulsa product division.

Stillman's appointment is related to a general expansion program at Farris which has extended its product line to include steam traps, fuel economizers, and extrusion take-off machines. A new Canadian plant with manufacturing, service, and repair facilities was opened recently for Farris Industries Canada, Ltd.

Patrick L. McManus becomes

. . . general manager of Worthington Corp.'s Standard Pump Division at East Orange, N. J. He was formerly director of marketing services at the company's headquarters in Harrison, N. J. McManus joined Worthington in 1936. He was named San Francisco district office manager in 1952, assistant general sales manager and eastern regional sales manager in 1959, and director of marketing services last year.



JONES & LAUGHLIN SUPPLY DIVISION recently shipped three LACT units and a trailer-mounted prover tank from its Tulsa manufacturing facilities to two oil companies in North Dakota and Montana. Just recently J&L purchased some of the assets of Major Engineering Co. and began manufacture of LACT and related equipment in Tulsa. Two of the units in this shipment are insulated and contain thermostatically controlled electric heaters for cold-weather operation. For portability the 10-barrel-capacity prover tank is mounted on a trailer.

John W. Hakeman is named

. . . assistant to James E. Stockton, Jr., general sales manager for Tretolite Co., St. Louis. Hakeman was formerly assistant Rocky Mountain division sales manager for Tretolite Co., division of Petrolite Corp. Hakeman goes to St. Louis from Edmonton, Alta., and succeeds A. J. Fox, who recently was made sales manager of the Eastern Hemisphere Division of Petrolite, Ltd., with headquarters in London, England.

Newly appointed field service engineers for Tretolite include: Jerry Worsham, previously with Dowell Division, to Levelland, Tex.; Joe W. Moore, formerly with Plastic Applicators, to Odessa; and Billy Johnson, formerly with Dayton (Texas) Industrial Schools, to Corpus Christi. Recent transfers of Tretolite representatives were: James Gregory from Andrews to Beeville, Tex.; and James Beasley from Abilene to Houston.

William O'Bannon joins

Wm. O'Bannon

. . . Parks Equipment Co. as engineering assistant to R. J. Walker, vice president and general manager. For the past 10 years O'Bannon has been actively engaged in the design, manufacture, installation, and operation of various types of field-processing equipment. He has been especially active in the development of rapid-cycle hydrocarbon-recovery plants and associated automatic-control equipment.

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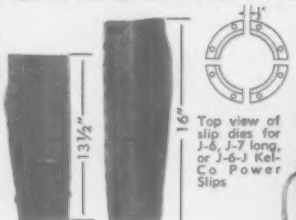
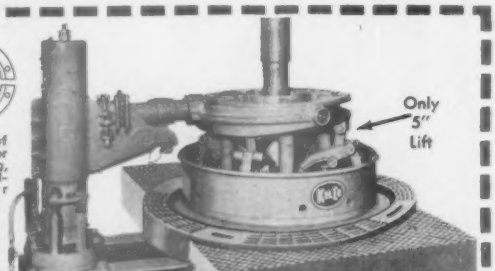


KelCo Standard and Long Dies Give More Pipe Contact

Top view of slip dies for J-6, J-7 long, or J-6-J Kel-Co Power Slips



Model J-6 Regular, J-7-Long, and J-6-J Slim-Hole Power Slips

Casing Power Slips Tubing Tongs

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Montreal Engineering-Mannix established in Calgary, Alta.

. . . to provide engineering and construction services to all phases of the petroleum, gas, and chemical industries. The new firm is a joint venture of two Canadian organizations—Montreal Engineering Co., Ltd., and Mannix Co., Ltd. The former is associated in consulting engineering services in Canada and abroad; the latter is a heavy-construction firm.

General manager of Montreal Engineering-Mannix, George Roy Sorrenti, takes to the position 10 years of experience in the gas-processing field. Previously Sorrenti was vice president of Gas Machinery Co. (Canada), Ltd., where he worked principally in the area of packaged-type gas plants and dehydration plants.

John B. Moriarty assumes post with Darling Valve & Mfg. Co.

. . . as a sales representative assigned to the New York eastern regional office representing the company in Metropolitan New York and Long Island. Before joining Darling Valve, Moriarty was a sales engineer for Champion Electric Co. and Westinghouse Electric in New York City.

B. F. Goodrich Co. sets up industrial marketing group

The Akron, Ohio company announces consolidation of various divisions' marketing responsibilities into a new industrial products marketing organization. James C. Richards, formerly vice president—sales of the company's Industrial Products Division, heads the new organization as vice president—marketing, industrial products. He reports to P. W. Perdriau, division president.

The new marketing group has responsibility for such products as conveyor and transmission belting, hose, molded and extruded rubber and plastic products, and vinyl pipe and sheeting manufactured by the company's Industrial Products Division.

Gordon G. Guiberson elected as chairman of the board

. . . of Guiberson Corp., one of the Dresser industries. Associated with the oil industry since 1932, Guiberson was named executive vice president and general manager of the company in 1937. He became president in 1951. Taking over as company president is Robert L. Boyd, formerly executive vice president.

James Bowen named sales mgr.

J. D. Bowen

. . . for Raytheon Co.'s Sorensen product lines, it was announced by George B. Estes, manager of industrial operations. Prior to joining Raytheon, Bowen was eastern sales manager for Sola Electric Co. and a sales engineer for Sorensen & Co., Inc., before that firm was acquired by Raytheon in 1959. Earlier he was a design engineer for E. I. Du Pont, Wilming-

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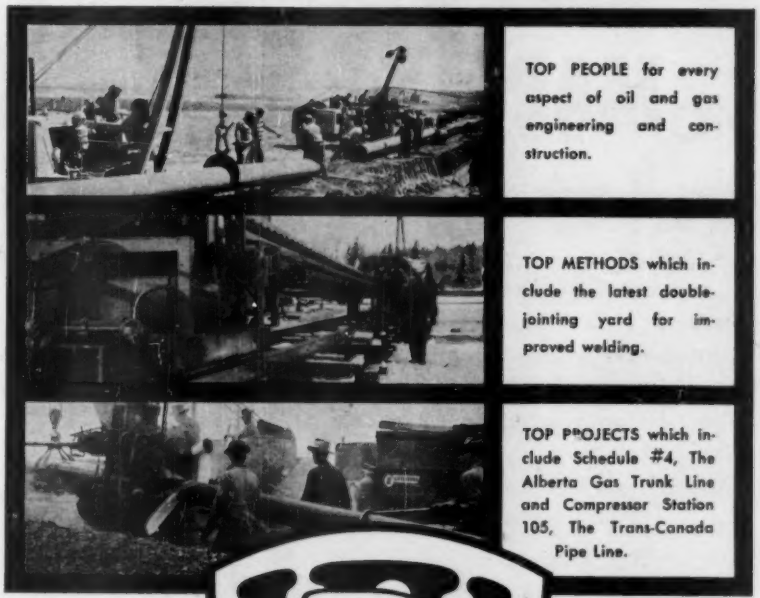
TOP METHODS
TOP PROJECTS



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TOP METHODS which include the latest double-jointing yard for improved welding.

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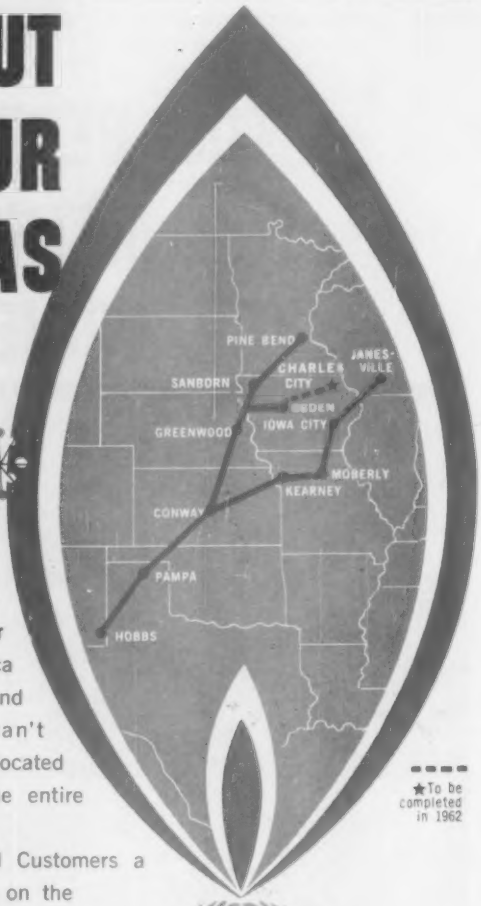
ton, Del. In his new post, Bowen will direct sales of power supplies, voltage regulators, inverters and converters, frequency changers, cable testers, meters, and accessories.

Clark Bros. Co. names four

. . . sales engineers for Clark engines, compressors, and gas turbines. M. S. (Mel) Kenady, assigned to the Amarillo office, has been in sales engineering in the gas-petroleum industries since 1945. Z. B. (Zobo) Deer, Tulsa office, transferred from Amarillo after 2 years in sales engineering there. He was previously in supervisory work with Celanese Corp. of America.

At the Houston office is Edward S. Leonard. He has been in application engineering, sales engineering, and marketing work at Clark headquarters in Olean, N. Y. for more than 10 years. Thomas R. Bett's assignment is at Shreveport, following 4 years as application engineer there and previous work in the Clark marketing section in Olean.

PUT YOUR LP GAS ON THE MAP



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Do your Distributors and Customers a favor — put your products on the M.A.P.* call —

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Erath, Inc. makes appointments

Louis W. Erath, president and founder of the 5-month-old Houston industrial electronics designing, consulting, and manufacturing firm, has named E. H. Urquhart to the position of marketing manager; Norman Turner, engineering design and project coordination manager;

L. W. Erath

E. H. Urquhart

John H. Davis, Jr., corporate treasurer and business manager; and Anne W. Jones, corporate secretary and office manager.

Norman Turner

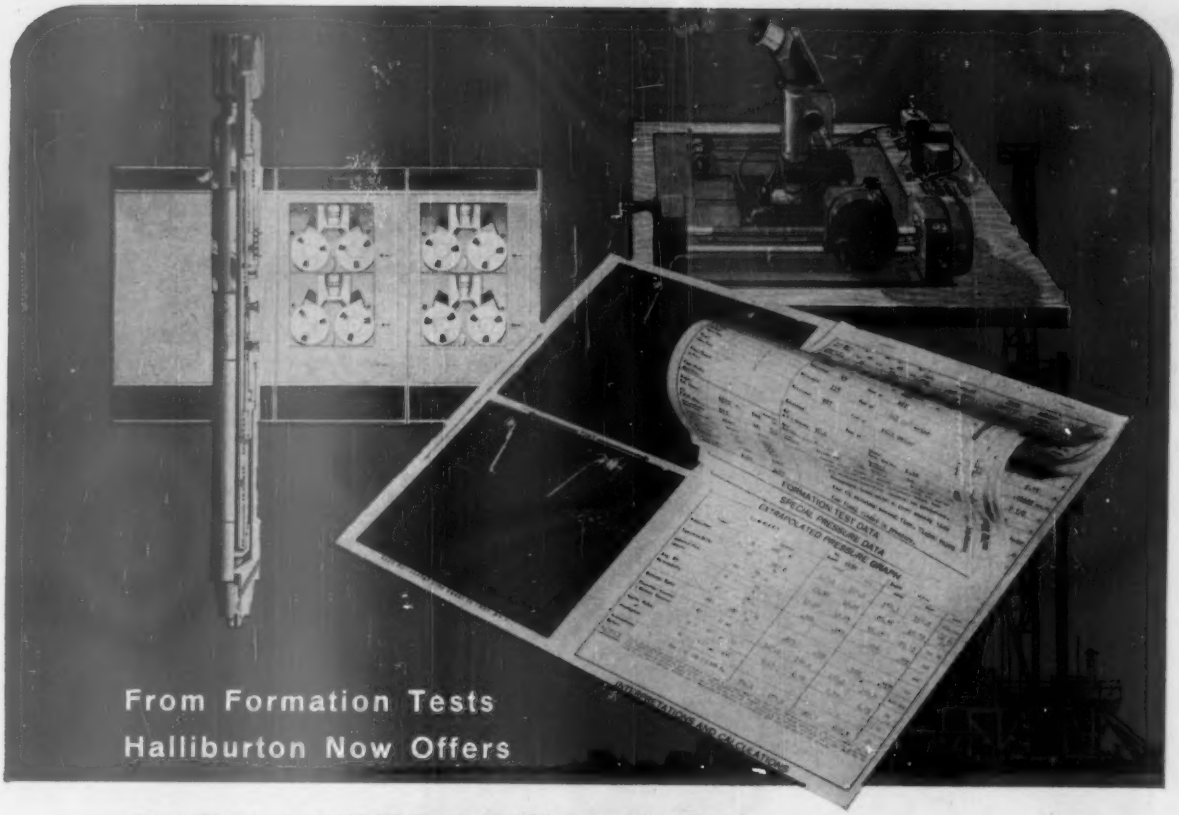
J. H. Davis, Jr.

Erath, formerly senior vice president of Dresser Electronics' SIE Division, said the appointments will provide for electronic consulting services, instrument design and development, custom manufacturing, instrument modification, and maintenance.

Urquhart joined Erath, Inc. following his recent resignation as executive vice president and operating head of Kexplore Electronics, Inc., Houston. Turner was previously manager of the Well Logging Engineering Division of SIE. Davis formerly served as business administrator of SIE's engineering department for 4 years.

Dr. Ernest Koenigsberg to direct

. . . operations research for the San Francisco data-processing center of C-E-I-R, Inc., according to Daniel Haagens, director of the center. Dr. Koenigsberg will direct problem analyses for a variety of businesses and industries where application of large-scale computers can provide economical solutions.



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This valuable advisory service translates test information into the values needed to help guide your all-important decision to complete, stimulate or abandon the well. Here's the data that Halliburton's Calculation and Interpretation Service provides for you:

- ***PRODUCTION*** – what the well should make now, upon completion.
- ***TRANSMISSIBILITY AND FLOW CAPACITY*** – Permeability data in millidarcy feet.
- ***AVERAGE EFFECTIVE PERMEABILITY*** – based on net pay log or tested interval.
- ***DAMAGE RATIO*** – the extent of permeability damage near the well bore.
- ***THEORETICAL PRODUCTION*** – what the well should make if "skin-effect" damage were removed by acidizing or overcome by fracturing.
- ***RADIUS INVESTIGATED*** – The approximate radial extent of the test.
- ***POTENTIOMETRIC SURFACE*** – valuable data for reservoir engineering and exploration geology to help better define future potential pay locations and well sites.

Take advantage of this important extra service on your next Dual C. I. P. Test. Make it a Halliburton Test . . . for results you can count on.

No warranties are made in connection with this advisory service.

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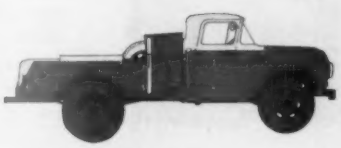

TESTING SERVICES

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CARGO is loaded at Port of Houston dock for voyage to British Honduras.

Drilling rig heads for British Honduras

RECENT ACTIVITY at Houston included the loading of a 71,000-lb. mobile drilling rig along with other equipment and supplies on the M/V Inagua Arrow for shipment to British Honduras. The rig will be used by Gulf Oil Corp. to obtain geological information in the Central American nation.

Contractor for Gulf is Carmack Drilling Co. of Denver who will do the core drilling. Further drilling in the form of wildcat wells depends upon the results of these investigations.

The rig is lifted aboard the vessel by a huge floating crane. All metal on the unit was coated with an antitrust covering to protect it during the 4-day voyage.

These operations will be supervised by Gulf's Western Hemisphere exploration headquarters at Coral Gables, Fla. Howard Cobb, manager of British Honduras operations at Belize, will oversee the drilling.

Bethany still paces East Texas activity

SINCE 1916 Bethany field of East Texas has been among the leaders in drilling activity. Not only does the play encompass most of northeast Panola County, but it spills over to the north into Harrison County. Not content to be confined to a single state, drillers are also active across the line in Louisiana.

The big attraction of the area is the multiplicity of pays with good yields at shallow depths. According to recent reports, there are at least 30 active operations at Bethany in Panola County alone. Although the section has been checked to depths of 11,300 ft., reaching the Jurassic-Cotton Valley, most of the current allure is less than 4,000 ft.

Dual and triple completions are not unusual. One well now drilling has already brought in production from the Mooringsport and Jenkins, and is preparing to complete a third zone uphole in the Paluxy.

A typical section shows the markers as: Navarro 907 ft.; Nacotoch

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As president of Zephyr Drilling for 8 years and an officer of the company nearly 20, Mac McClintock, our President, learned the oil business from the "bottom hole" up. And as a director of First National for 11 years, he has combined his knowledge of oil and banking in a significant contribution to the stature and experience of our Oil Department. All this means better oil banking for you when you . . .

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sand 1,065 ft.; Sara sand 1,293 ft.; Annona chalk 1,502-1,650 ft.; base Ozan chalk 1,770 ft.; Buckrange sand 1,805 ft.; Blossom sand 1,976 ft.; Austin chalk 2,243-2,393 ft.; first Lower Cretaceous in Fredericksburg 2,401 ft.; Paluxy 2,611 ft.; Glen Rose (Texas equivalent) 2,992 ft.; Jenkins sand 3,750 ft.; Woolworth sand 3,777 ft.; Glen Rose (Louisiana equivalent) 3,818 ft.; stray Anhydrite stinger 3,860-64 ft.; Mooringsport lime pay zone 3,878 ft.

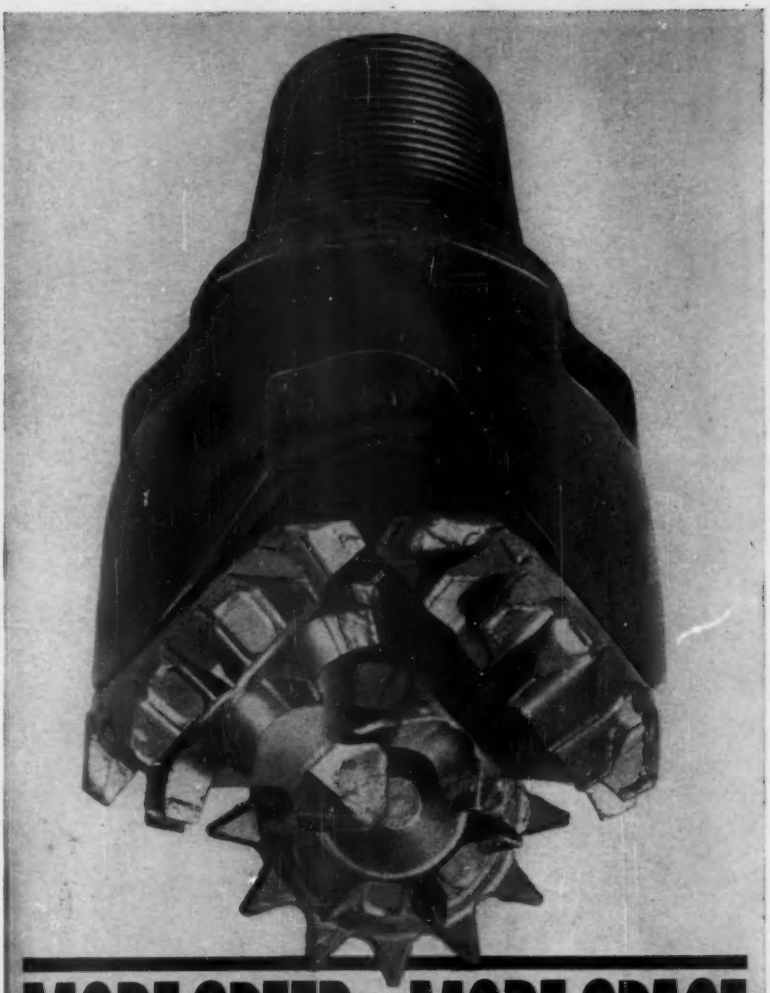
Not solely an independent's play, operators include: Texaco Inc., Union Producing Co., Socony Mobil Oil Co., Skelly Oil Co., Lomac Drilling Co., C. A. Bryan, and M. G. Hansbro. Texaco is the most active operator in the field.

The prime objective is the Mooringsport found at depths of 3,800 to 4,000 ft. Other targets include Nacatoch, Rodessa, Pettit, Travis Peak (the latter three are below Mooringsport), along with Paluxy, Jenkins, Woolworth, and Glen Rose, above the Mooringsport.

Typical yields are good. Completions methods vary slightly according to the operator. A Jenkins sand well had an IPF of 127 BOPD with 5% water. Gravity of the oil was 43.5° with a gas-oil ratio of 225 to 1. This well was fracture treated with 60,000 lb. of sand. A Mooringsport well made an IPF of 116 BOPD on a 20/64-in. choke and tubing pressure was 180 lb. Gas-oil ratio was 250 to 1 and oil was 43.5°. This zone was treated with 1,000 gal. acid and fractured with 17,400 lb. of sand, 2,500 lb. of walnut hulls, and 2,300 bbl. of salt water. A Woolworth sand well was treated with 6,000 lb. of sand, 900 lb. of hulls, 900 bbl. of water, and 500 gal. of acid.

Another Mooringsport well made 182 bbl. daily through an 18/64-in. choke. Gas-oil ratio was 476 to 1 of 41.8° oil. Shut-in tubing pressure was 455 lb. in 1 hour.

Casing programs usually consist of running 10¾-in. surface to 266 ft. and setting with 190 sacks of cement. Either 7-in. or 5½-in. casing to 3,950 or 4,000 ft. with 300 sacks of cement. Tubing run is usually 2⅜-in. Completions are made through casing after electric log and acoustic-caliper logs are run. Common procedure is to core and drill-stem test potential pays.



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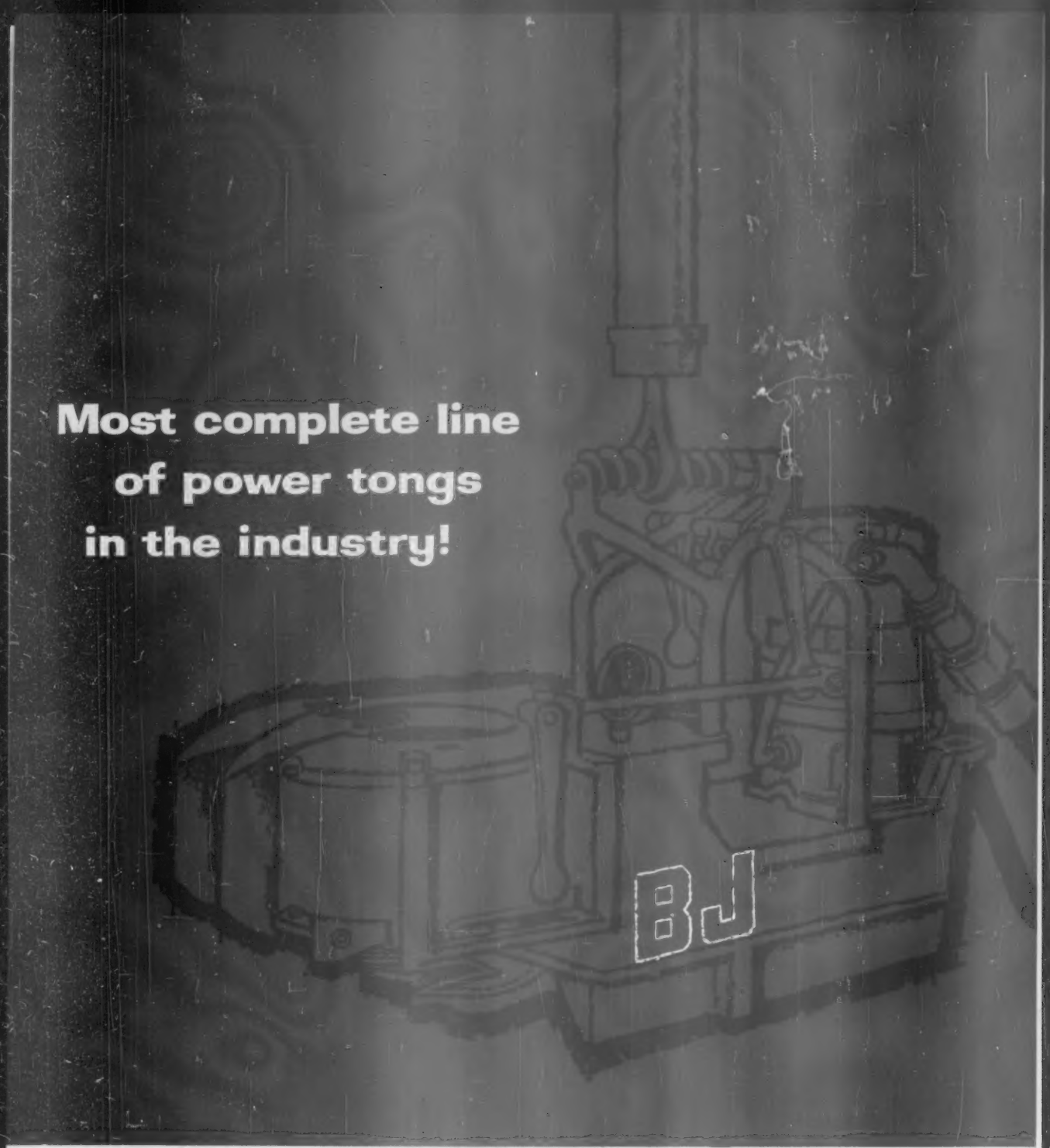
AIR FRANCE CARGO



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BJ
QUALITY COSTS LESS IN THE LONG RUN

. . . as state hosts three big meetings

IF YOUR GEOLOGIST turns up missing next month, he'll probably be somewhere in Texas. For 3 weeks running, that state will host important regional geologic meets, one at Amarillo, one at San Antonio, and another at El Paso.

At Amarillo . . . First on the docket is the Mid-Continent regional meeting of the AAPG, to be held in Amarillo on October 18-20. The theme song there will be "Natural Gas on the Move." And an advance look at the program reveals an interesting list of subjects. The rockhounds will hear papers on exploration, stratigraphy, economics, reservoir rocks, and storage. Not only natural gas comes under study, but its two maverick components, carbon dioxide and helium, will receive a lot of attention. Most intriguing title on the program: "Let's Explore for Friends, Too."

San Antonio . . . A week later, on October 25-27, 11 separate societies of the Gulf Coast region will meet as one, when the Gulf Coast Association of Geological Societies holds its eleventh annual convention in San Antonio. Here, the emphasis will be on geological history of the Gulf Coast, and the program drips with stratigraphy and tectonics. An international flavor is injected into this meeting, with three papers on the Mexican gulf coast. This has been designated a fall regional meeting by the AAPG. For one night at least, the delegates will make like they're south of the border, as the San Antonio hosts stage "A Night in Old Mexico" as a major entertainment feature.

And El Paso . . . The El Paso gathering has many facets. It's the fourth annual meeting of the Southwestern Federation of Geological Societies, Southwestern regional meeting of the AAPG, and a true international convention, with the Roswell Geological Society acting as host in cooperation with the Association Mexicana de Geologos Petroleros. This one takes place November 1-3. Following the theme pattern, the program emphasizes the sedimentary and tectonic framework of northern Mexico and southwestern United States. Again, stratigraphy and tectonics will hold the spotlight.

The El Paso group will outdo the San Antonians by actually transporting its guests across the Rio Grande for a night in Old Mexico.

New problems will be met . . . Summing up the three programs, we find stratigraphy the No. 1 subject and tectonics in second place.

This emphasis on stratigraphy and tectonics stems, no doubt, from the fact that each of the three geological groups has faced new challenges in exploration in very recent times. The Gulf Coast region is concerned with new Jurassic and Lower Cretaceous problems as those formations forge to the front as new oil and gas targets. In the Southwest, explorationists are looking at untested basins in southwestern New Mexico and trans-Pecos Texas. And the Mid-Continent geologist is faced with a two-way challenge in the Anadarko and Arkoma basins.

It's appropriate, then, that Texas should serve as the sounding board for all three groups, for Texas real estate is involved in all but one of those challenges.

What are the chances for oil in Puerto Rico?

THE ISLAND is divided into three distinct belts. The north and south are post-Eocene and have potential. The central belt is Upper Cretaceous with igneous intrusions with little hope for oil.

Possibly the best chances for oil may be in the northern sector or immediately offshore. The few tests that have been made cannot condemn the island.

FOLLOWING the drilling of the first deep test in northern Puerto Rico last year, the samples, cores, and stratigraphic data since have been studied in detail. From these data, a report made by the USGS has been recently published which is entitled "Oil and gas possibilities of northern Puerto Rico."

Kewanee Interamerican Oil Co. drilled the 4 Commonwealth of Puerto Rico (4CPR) well in August and September 1960. The test reached a total depth of 6,434 ft. and bottomed in Eocene rocks which were largely volcanic sandstones and siltstone. About 1,500 ft. of Middle Tertiary section had good porosity and permeability with its reeflike lithology.

History. Although the northern test, the 4CPR, was not the deepest that has been drilled in the country, it was the most encouraging to date. Since 1959, Kewanee has drilled four tests altogether on the island. Three of these were located on the south coast. The 1CPR was finished in April 1960 west of Santa Isabel and went to 7,480 ft. The 2CPR, east of Pastillo, reached 4,919 ft. and was completed in May 1960. The third venture, 3CPR was drilled to 4,152 ft. in June 1960.

On the entire island no seeps or hydrocarbon deposits have been found and none of the tests drilled have encountered any gas or oil shows. Of all the wells drilled, the 4CPR is the most encouraging because of the favorable porous section found in Middle Tertiary section. The center of the island is considered the least likely for petroleum accumulation. The east-west central belt is mostly Upper Cretaceous rocks associated with igneous intrusions, probably related to the mountain-building forces which formed the island.

Both north and south of the central belt are post-Eocene sediments which are Oligocene and Miocene in age. The southern strip is smaller in areal extent than the northern belt of post-Eocene rocks (Fig. 1). Furthermore, the post-Eocene beds thicken and dip to the north. This thickening of beds provides greater possibility of better targets to the north. It is seen from the stratigraphic column (Fig. 2) that the best potential reservoir beds are above the Eocene.

Where are the traps? If oil and gas are present in Puerto Rico, it is likely that accumulations will be localized in either structural or stratigraphic traps. The Tertiary rocks have been subjected to relatively slight folding, and no folds reflected in the surface beds appear likely to afford structural traps. The single

large structural anomaly observed in the north central plain, the Aguadilla flexure, has no closure on the southeast.

In the south coastal plain, the Juana Diaz anticline and the Penuelas anticline, may have closure, but the crests of these structures are evidently underlain by only a relatively thin section of Tertiary rocks. Geophysical surveys conducted between 1947 and 1949 disclosed possibility of further structural indications in the south coastal plains.

For the most part, stratigraphic traps may prove to be the best target for finding oil and gas. Some faulting has been mapped over the island. Whether the indicated faults can provide adequate traps is purely conjectural at present. The tidelands offshore from the island may prove productive. One area 7 miles offshore was examined by marine seismic techniques.

Trap possibilities may occur along a large strike fault to the north just east of Arecibo. Facies changes are apparent and in the south coastal plain a wedge of the Juana Diaz formation may be present beneath the overlapping Ponce limestone in an area west of Guanica. Along the north slope there is possibility of a subsurface wedgeout of clastic sediments of the San Sebastian formation southward between the Cretaceous basement and the Iares limestone. Also in the north, the seaward extent of the great bioherms of the Iares lime is unknown. If the reef-type limestones interfinger seaward with more clastic sediments, as they do laterally, conditions could be favorable for presence of stratigraphic traps.

Conclusions. The faulting that has been found is of a minor nature and do not exceed displacements of 115 ft. in the northern post-Eocene belt. However, the Middle Tertiary sequence east of Arecibo may be offset by a relatively large strike fault which is indicated largely by indirect evidence.

Several geophysical surveys have been conducted. These include reflection seismopgraph, gravity, and aeromagnetic investigations.

The most encouraging aspect of the wells that have been drilled is the information obtained about the stratigraphy. The 4CPR revealed that a good permeable and porous section in the post-Eocene beds would make an excellent reservoir if they were hydrocarbon bearing. This was not the case—no shows were encountered—but it will take more than one dry hole to condemn the entire northern belt.

In addition to the geophysical work which has been done, surface investigations have been made. Whether the island has been completely and thoroughly surveyed is a moot question. Only two firms, Kewanee and Shell, have conducted prolonged exploration work in Puerto Rico. In addition to these companies, the USGS has done extensive work on the island.

"Oil and gas possibilities of northern Puerto Rico" is available through the auspices of the Puerto Rico Mining Commission, working in conjunction of the USGS, and was written by Reginald P. Briggs, of the USGS. Copies are available free on application to Carlos Vincenty, Executive Secretary, Puerto Rico Mining Commission, Box 38, Roosevelt, P. R.

Puerto Rican Stratigraphy

System	Series	
TERTIARY	LOWER MIOCENE	Aymamon Limestone 0-1,270 ft.
		Aguada Limestone (?) 1,270-1,480 ft.
		Aguada Limestone 1,480-1,850 ft.
		Cibao Formation 1,850-2,852 ft.
	UPPER OLIGOCENE	Lares Limestone 2,852-4,505 ft.
	MIDDLE OLIGOCENE	San Sebastian Formation 4,505-5,525 ft.
		Unconformity 5,525′
	EOCENE ?	5,580′ *(Abundant volcanic sandstones and siltstones 5,580-6,434 ft.)*
		Total Depth 6,434 ft.

KEWANEE 4 CPR WELL provided a basis for stratigraphy in the northern belt. Here's the sequence as shown by samples.

Deep wildcat to drill off lower Texas coast

Drilling of a deep wildcat in the Gulf of Mexico 9 miles off the Padre Island shore of Kleberg County, of the lower Texas coastal region, is scheduled by Socony Mobil Oil Co.

Its location will be in the northwest corner (3,300 ft. from the north line and 1,000 ft. from the west line) of Block 859-Large, in the Mustang Island area.

This is 1,980 ft. south and 2,320 ft. east of a 12,448-ft. dry hole drilled earlier this year by Tennessee Gas Transmission Co. Tennessee's test was in the northeast corner of the adjoining Block 860-Large.

Socony Mobil's plans call for a 12,500-ft. test.

Location is 40 miles southwesterly from Corpus Christi. It is 8 miles almost due east from a lone gas well, just a mile offshore, which Sun Oil Co. drilled in 1957 and designated as Sprint field.

Gas discovery opens new Louisiana field

A new gas-condensate discovery has been made by M. P. S. Production Co. in southeastern Calcasieu Parish, southwestern Louisiana.

It is 1½ miles from nearest production, being Bell City field on the northwest, the East Bell City

field on the northeast, and the South Bell City field on the southeast.

Discovery well, 1-A Sweet Land, flowed at the rate of 3 M.M.c.f.d. of gas through 13/64-in. choke. Liquid recovery was 84 bbl. of 54.8°-gravity condensate. Flowing pressure gaged 3,400 psi.

Production is from 4 ft. of sand at 10,407-11 ft. with bottom of hole at 11,145 ft.

South Texas wildcat tests dry gas flow

The first of two wildcats drilled by Cherosage Enterprises, just southwest of Hebronville, in northern Jim Hogg County, South Texas, has been completed with an open-flow potential of 16 M.M.c.f.d. of dry gas.

This well, 1 Myrtle Draper, is productive from perforated interval of 3,493-95 ft. in Government Wells sand. It was drilled to 3,620 ft.

The other well, 1 I. B. Gutierrez, less than a mile southwest of the Draper discovery, still is shut in waiting on potential tests. It was drilled to 3,538 ft.

They are about 2½ to 3 miles west of production in South Hebronville field.

Work due Alberta's Wimborne

D2 is new target in previous D3 reef development.

THE WIMBORNE DISTRICT of southern Alberta, 55 miles northeast of Calgary is in for another spurt of development drilling.

The field up to this time has primarily been a D3 development sector. Earlier this year the team of British American Oil Co., Ltd., and Banff Oil, Ltd., encountered commercial oil success in the D2 (Nisku) horizon and it is on the basis of that strike and a single followup success that the new program is evolving.

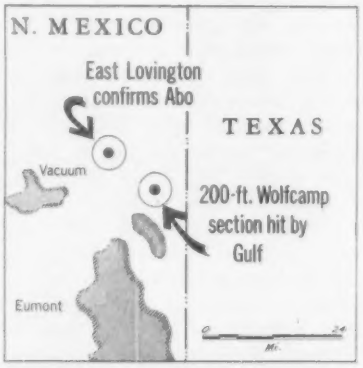
The initial D2 success was drilled along the west flank of the field. The well found porosity only 1¼ miles west of a well in which 2 ft. of porosity was found. The zone was contacted some 60 ft. lower. Following the discovery the same two firms decided upon a cautious followup program and started the offset well only ¼ mile from the strike. Recently that well, too, yielded commercial oil production and it seems now that all caution has been thrown to the wind as, in addition to another offset location both firms included in the discovery team have staked stepouts to the pool and another company is presently readying location for another stepout.

Discovery. Original discovery well was the B.A.-Banff 10-27-33-26 Wimborne venture on LSD 10, 27-33-26w4. From a 62-ft. net pay sector the team established an initial potential of 260 bbl. of oil per day through restricted choke. That venture also found oil in the Wimborne D3 reef but as the D2 appeared to be the better of the two the well was completed from it. The initial followup, meanwhile, B.A.-Banff 11-27-33-26 Wimborne—1¼ miles west—is just being production-tested but initial flow rate was enough to spur the additional step-out drilling.

Actually, the porous sector in the newest success is comparable to that found in the discovery while the gross pay is indicated from logs at 66 ft. Unlike the initial well, it was not carried to the D3 reef section but bottomed at 7,412 ft. and following setting of production casing, tubing was run, perforations made of an 8-ft. interval below 7,346 ft. and the formation acidized. Initial flow rate over a 6-hour period was measured at 48 bbl. of 36.2°-oil through a 30/64-in. choke—or a calculated daily rate of 192 bbl.

Four additional well sites have now been staked in the district for D2 development (although one or two may be carried down to take a look at the D3 as well) and at least the four rigs needed for them will be active. One of those rigs will be used by the discovery team on a direct south offset to the initial strike while Banff will use another on a 1½-mile stepout to the northwest; British American will use another for a wholly-owned 1¼-mile stepout to the southwest and the team of Canadian Oil Co.'s, Ltd. and Plymouth Oil Co. will activate the other at a 1 mile extension test to the south.

What further development will be done in the area will depend largely on the four drill sites presently contemplated. It does not appear that many more companies will get involved, however, as British American, Banff, and the Canadian Oil team are the only ones with acreage close by. Hudson's Bay Oil & Gas Co., Ltd., could be attracted later as it does have a fairly sizable block 2 miles to the west of the present successes.



TWO WELLS highlighted Southeast New Mexico's exploratory news last week—one found Wolfcamp production, the other confirmed East Lovington Abo field.

Wildcats confirm East Lovington

TWO LEA COUNTY discoveries put New Mexico on the go last week. Gulf Oil Corp. tested 200 ft. of Wolfcamp pay at 1 Levi Harris in C SW SE 21-17s-38e, 3 miles southwest of South Knowles Devonian field, and Aztec Oil Co. 1 State "VA," C NW NE 20-17s-36e, confirmed Abo reef production at East Lovington.

The Gulf well topped the Wolfcamp Permian at 9,500 ft. Gas flowed on tests at 9,690-9,762 ft. and 9,885-9,924 ft. Flow was 320

M.c.f.d. on the latter test. A 1-hour test at 9,855-9,924 ft. got gas. Free oil was returned on a test at 9,990-10,040 ft. Recovery was 2,615 ft. of free oil. A test at 10,035-90 ft. got gas and 55 bbl. of oil in 4 hours. A test at 10,110-60 ft. also got free oil. Drilling continues below 10,737 ft. Devonian at 12,700 ft. is the goal.

East Lovington. The third try to confirm Abo production in this Lea County field was a success. The pool was opened last December by Sunray at 1 State "X." North and west offsets were dry.

Aztec Oil & Gas Co. went ½ mile east of that well to 1 State "VA" in C NW SE NE 20-17s-36e. The well was completed flowing 624 bbl. of oil per day on 24/64-in. choke from perforations in the Abo at 9,177-97 ft.

Delaware discovery finaled in Eddy County, New Mexico

Delaware sand production is reported at a wildcat in southern Eddy County, Southeast New Mexico. The well is Gulf Oil Corp. 1-BO Littlefield, 2 miles east of Corrall in 34-26s-29e, 3 miles southwest of a lone Delaware producer.

The well flowed 22 bbl. of oil plus 8 bbl. water in 24 hours through 22/64-in. choke from perforations at 2,898-2,970 ft.

Geological test is dry in eastern Kentucky

A deep (geologically) test in Mason County, eastern Kentucky, has ended in failure as United Fuel Gas Co. plugged and abandoned its wildcat 1 Wilson Rawlings as a dry hole.

Well was located in the Orangeburg Quadrangle 15-Y-71, 75 ft. from the west line and 950 ft. from the north line. No formation tops have been released but well was reported to have been bottomed in Precambrian granite at a total depth of 3,314 ft.

One new oil pool found in Illinois in August

One new oil pool, Buckhorn in Brown County, was discovered in Illinois in August. The discovery well is the 1 R. Davis drilled by L. P. Johnson in 33-1s-4w a little over 1½ miles north of Siloam pool.

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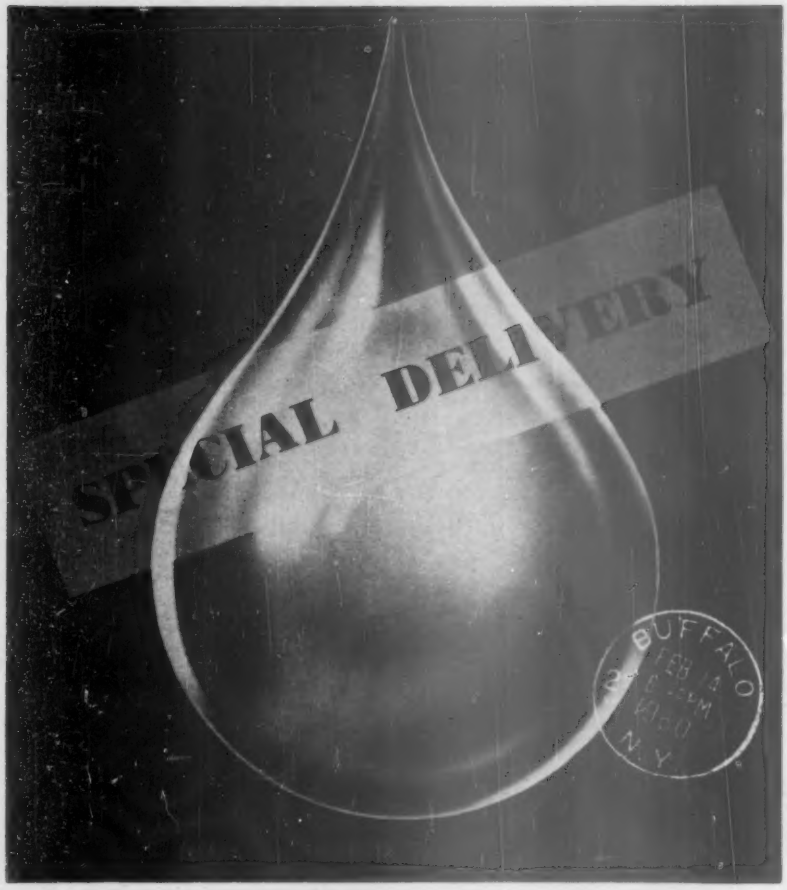

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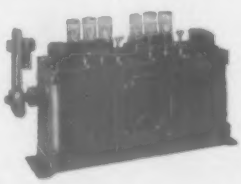

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Reported initial production was 48 bbl. of oil a day from Silurian lime.

There were also nine oil-well and one gas-well extensions to pools, as follows: one oil-well extension each to Mount Auburn Consolidated pool in Christian County, Clay City West Consolidated in Clay County, West Frankfort Consolidated pool in Franklin County, Ritter in Richland County, Eldorado Consolidated in Saline County, Roby in Sangamon County, and Phillipstown South, Storms Consolidated, and Sumpter East in White County; the gas-well extension was to Westfield pool in Clark County.

A total of 185 new oil and gas tests was completed in the 4-week period. The new tests resulted in 88 oil wells and 7 gas wells, a success ratio of 51%. In addition, five wells that previously had been completed as dry holes were reworked or deepened and recompleted as oil wells.

In 32-2s-9e, Wayne County, about 3 miles south of Goldengate, Collins Bros. et al. reopened an old hole in Goldengate Consolidated pool that had been completed as a dry hole in 1957 at a total depth of 3,317 ft. The well, the 1 Wood "A," was deepened to a total depth of 5,389 ft. and recompleted as a flowing well with an initial production of 272 bbl. of oil a day, through ⅛-in. choke, from the Dutch Creek sand of Devonian age at 5,346 ft. This is a new pay zone for the pool.

Estimated production for Illinois in August is 6,547,000 bbl.

Indiana is site of new oil play

A fast moving and successful oil play is developing at Point field in Posey County, Indiana, 8 miles southwest of Mount Vernon.

Development is in sections 5-8 in 8s-14w. Several operators are working in the area. Some of the wells have made as much as 960 bbl. per day flowing, following fracture of the Aux Vases Mississippian sand. The most recent completions include: Temple Drilling et al. 1 Yeida-Hughes-Stevens unit in NW NE NE 8-8s-14w.

This well made 300 bbl. per day, pumping after fracture of the Aux Vases at 2,644-60 ft.; George A. Hoffman 1 Elizabeth Mackey in SW SE SE 6-8s-14w. It pumped

166 bbl. per day after fracture in the Aux Vases at 2,714-29 ft.; Charles Micheli et al. 1 Frank Ford unit in SE SW SE 6-8s-14w. It pumped 75 bbl. per day from 2,724-38 ft. Other operators in the area are: F. E. Anderson and Son, Burns Drilling Co., William E. Hill, and Kendall-Davis Drilling Co.

Canadian wildcat will be completed

Fort St. John Petroleums is operator of a project involving the recompletion of 9-L Farrell Creek, a wildcat in northeastern British Columbia. This well was formerly the Imperial-Calvan 9-L Farrell Creek, 45 miles west of Fort St. John town, 8 miles southwest of Halfway Lake gas field, 5 miles southeast of Kobes gas field, and about 5 miles northeast of a dry hole.

Began in 1956. This drilling story began in 1956. Imperial Oil Ltd., through the acquisition of B. C. Permit 120 via the farmout route and in conjunction with Calvan Consolidated Oil & Gas, Ltd. (now Canadian Fina), undertook the drilling of 9-L Farrell Creek. The hole went to 8,005 ft. Drill-stem tests taken found gas from various zones. The best shows were at the 5,700 ft. mark in Halfway Triassic section. Flow rates of 1,500 and 1,450 M.c.f.d. were recorded. The operator didn't deem the well commercial and abandoned it in April 1957.

This could well have been the end of the wildcat, but certain involved interests were not satisfied with the decision to quit the hole. Court action gave a private group the rights to the dry hole as well as a spread of 5,340 acres around it. Fort St. John Co. entered the picture as the private group, wanting to become operator and did so. The company began recompletion in August this year. The hole was reconditioned, producing casing was run to shut off porous zones above the Halfway zone. The hole was opened up to 6,110 ft.; total depth is 8,005 ft. Casing was run to 5,103 ft. After acid treatment the well flowed up to 10 M.M.c.f.d. The well was later shut in. An absolute open flow test is due soon.

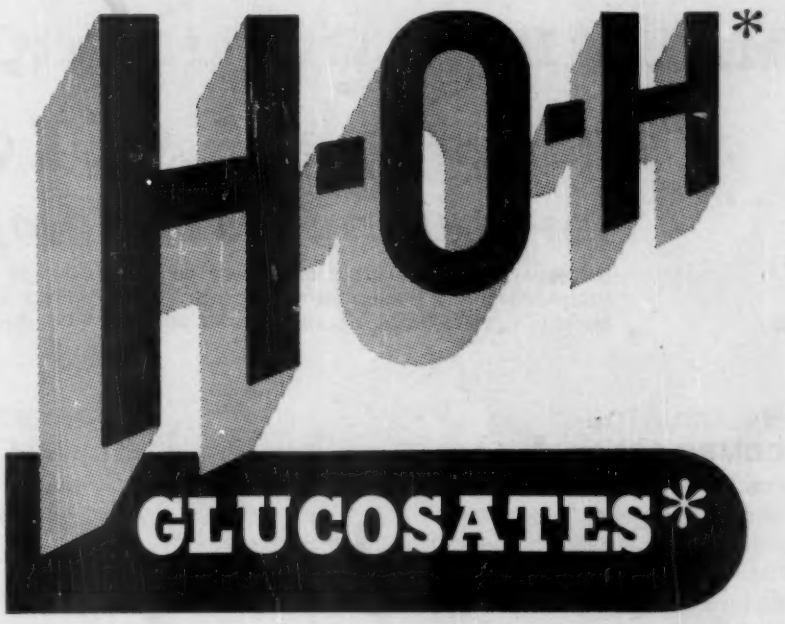
Fort St. John Co. is now negotiating gas purchase contracts with Westcoast Gas Transmission Co. The well is just 5 miles southeast of Kobes field, making market outlet easy. The well seems assured of success. It has 330 ft. of Halfway pay sand, fair porosity and fractures in the zone.

Lansing oil production set at Kansas confirmation

Lansing Pennsylvanian oil production is reported at a confirmation discovery in Park field, eastern Pratt County, Kansas.

Gordon Morain 1 Crick in SW NE SE 14-27s-11w, ⅜ mile east of the field discovery well, swabbed 41 bbl. of oil per hour for 3 hours. Perforations are at 3,807-13 ft. This field was discovered 2 years ago at Messman-Rinehart 1 Park, a workover discovery hole in NW SE SW 14-27s-11w. It made 137 bbl. per day from Lansing perforations at 3,800-3,804 ft.

Stevens County. Mobil Oil Co. 1 Anderson Trust unit, C SW NE 27-31s-35w, northeastern Stevens County in the Hugoton area of



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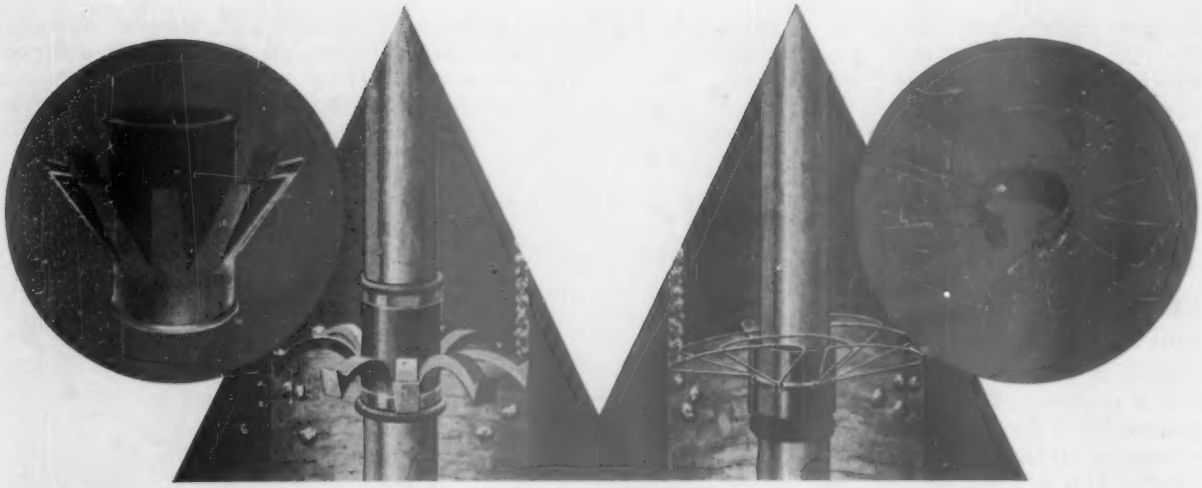

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is designed to remove filter cake from bore hole wall when cementing 2⅞" O.D. tubing for casing.

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Southwest Kansas, is a new oil discovery 3½ miles southwest of Cutter field.

The new well flowed 244 bbl. of oil daily based on an 8-hour gage of 41 bbl. through 14/64-in. choke from perforations in the Chester Mississippian at 6,003-34 ft.

Clark County. Sinclair Oil & Gas Co. completed a discovery well in southern Clark County, Southwest Kansas, 12 miles southeast of Ashland and 1½ miles west of West Tuttle field.

The 1 C. H. Tuttle, C NW SE 8-35s-21w, 2 miles south of Southwest Snake Creek field, flowed 8,500 M.c.f.d. with a trace of condensate from perforations in the Chester at 5,590-5,606 ft.

Fifth deep producer added to new Cambro-Ordovician pool

In Ohio, another test of the deeper sediments in the Canaan Township, Wayne County area has indications of being a combination oil and gas producer.

A 1¾-mile significant stepout southeast in Green Township, Wayne County, 1 M. A. Horst, Section 8, was finaled at a total depth of 5,799 ft. by Ohio Fuel Gas Co. The casing was notched at 5,785 ft. and the Cambro-Ordovician was acidized and fractured. Settled oil produtcion appears to be about 25 bbl. of oil per day; gas gaged has varied. This well marks the fifth success in this new field development.

Deep gas pay found in Texas coast oil area

Discovery last June of Northwest Big Hill field, in southwestern Jefferson County, Texas Gulf Coast, is being followed with the opening of a second pay zone for the new area.

Discovery well was oil productive from Frio sand at 8,927-37 ft. The new well, second for the area, is productive of gas and condensate from perforations at 8,886½-95½ ft.

Both wells were drilled by William K. Davis. He now is starting his third well.

Absolute open-flow potential of the second well, 1 W. S. Davidson Estate, is 8,300 M.c.f.d. of gas. Recovery of 52.6°-gravity condensate is in the ratio of 1 bbl. to 32 M.c.f. Shut-in pressure is 3,153 psi. at the top.

Location is 1,000 ft. northeast of Davis' discovery well, 1 Stockrider, completed last June with a flow of 199 bbl. of 37°-gravity oil daily through ⅛-in. choke.

The new discovery is off the northwest side of West Big Hill gas area. It is 8 miles southeast of Winnie.

Mississippian discovery finaled north of Lisbon in Utah

Mississippian gas-condensate production is reported at Pure Oil Co. 1 USA-Big Indian in SE NE 33-29s-24e, San Juan County, Paradox basin, Utah. The well flowed 7,400 M.c.f.d. plus 11 bbl. condensate per million from perforations at 9,886-10,150 ft. on 29/64-in. choke. Location is in the Lisbon trend, 3 miles north of Lisbon field. Calculated absolute open flow is 44 M.M.c.f.d.

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Slight Rise Noted in August Completions

	Total	Oil	Cond.	Gas	Dry	Service	Footage	Cum. wells 1961	Cum. footage 1961	Cable-tool compl.	D.D.
Alabama	0	0	0	0	0	0	0	31	344,001	0	0
Alaska	6	3	0	1	2	0	63,827	30	320,116	0	0
Arizona	4	1	0	0	3	0	8,809	17	37,513	0	0
Arkansas	42	13	0	5	24	0	171,529	330	1,249,873	0	0
California	178	126	0	20	30	2	713,938	1,119	4,928,389	0	14
Colorado	50	9	0	8	33	0	245,642	404	1,923,532	0	3
Florida	0	0	0	0	0	0	0	7	68,620	0	0
Georgia	0	0	0	0	0	0	0	1	4,500	0	0
Illinois	239	83	0	1	86	69	573,454	1,341	573,454	24	5
Indiana	102	40	0	2	59	1	158,305	484	695,636	61	0
Kansas	326	131	0	23	155	17	1,127,370	3,388	8,621,907	102	4
Kentucky	210	45	0	4	58	103	232,281	1,300	1,756,446	102	0
Louisiana	377	170	28	39	140	0	2,774,532	2,525	19,134,158	0	0
North	154	67	8	27	52	0	473,791	999	3,332,586	0	0
South	166	67	15	7	77	0	1,701,224	1,153	11,888,990	0	0
Offshore	57	36	5	5	11	0	599,517	373	3,912,582	0	0
Michigan	103	25	0	5	46	27	279,397	512	1,573,420	47	2
Mississippi	43	15	3	0	25	0	395,888	363	3,615,904	0	0
Missouri	4	0	0	0	4	0	5,538	31	52,969	0	0
Montana	37	19	0	0	18	0	210,803	251	1,371,657	0	0
Nebraska	94	27	0	0	67	0	428,823	677	3,061,514	0	0
Nevada	1	0	0	0	1	0	400	14	27,398	1	0
New Mexico	162	73	0	44	45	0	883,887	1,186	6,101,544	34	2
West	68	15	0	44	9	0	371,925	522	2,509,509	16	1
East	94	58	0	0	36	0	511,962	664	3,592,035	18	1
New York	23	13	0	0	0	10	31,050	324	462,883	23	0
North Dakota	21	13	0	0	8	0	168,967	175	1,112,619	0	0
Ohio	101	52	0	16	27	6	249,252	690	1,756,975	71	2
Oklahoma	459	236	6	40	148	29	1,732,496	3,898	12,782,675	58	15
Oregon	0	0	0	0	0	0	0	2	15,295	-0-	0
Pennsylvania	57	21	0	17	4	15	147,563	403	1,248,583	48	0
South Dakota	2	0	0	0	2	0	13,165	5	30,908	0	0
Tennessee	20	0	0	1	19	0	19,776	62	47,102	0	0
Texas	1,156	604	23	68	431	30	5,344,096	9,644	42,906,802	37	5
District 1	77	29	1	3	44	0	226,428	596	1,625,625	0	1
District 2	61	17	5	7	32	0	371,595	525	3,489,298	0	0
District 3	67	26	2	6	32	1	466,032	769	5,159,896	0	0
District 4	86	33	6	9	38	0	529,902	813	4,496,628	0	0
East (5 & 6)	85	40	1	0	44	0	503,302	816	4,154,119	0	0
District 7-B	126	54	2	7	63	0	365,673	1,213	3,634,637	11	0
West (7-C & 8)	314	221	1	13	69	10	1,749,137	2,394	12,255,185	18	4
District 9	260	143	5	2	92	18	701,727	1,736	4,477,147	8	0
District 10	80	41	0	21	17	1	430,300	782	3,614,267	0	0
Utah	12	5	0	0	7	0	71,943	162	928,348	0	0
Virginia	0	0	0	0	0	0	0	2	8,004	0	0
Washington	0	0	0	0	0	0	0	7	25,715	0	0
West Virginia	102	14	0	72	14	2	263,766	669	1,643,010	90	0
Wisconsin	0	0	0	0	0	0	0	6	8,100	0	0
Wyoming	57	26	0	7	24	0	258,217	618	3,113,099	0	2
Total Aug. 1961	**3,988**	**1,764**	**60**	**373**	**1,480**	**311**	**16,574,714**	**30,678**	**123,901,263**	***698**	**54**
Total July 1961	3,912	1,675	60	417	1,318	442	15,124,361	.....	.....	949	26
Cum. 1961	**30,678**	**13,706**	**622**	**3,015**	**11,068**	**2,267**	**123,901,263**	.....	.....	***6,245**	**550**
Cum. 1960	30,211	13,737	885	2,450	11,606	1,533	127,577,339	.....	.....	.....	.....

*Estimated.

. . . and in Canada

	All wells							Wildcats					
	Total	Oil	Gas	Dry	Service	Footage	Cum. 1961	Total	Oil	Gas	Dry	Footage	Cum. 1961
Western Canada	249	147	40	56	6	1,310,892	1,502	44	9	4	31	236,123	375
Alberta	160	87	38	29	6	1,009,425	995	31	8	4	19	196,557	258
Saskatchewan	77	55	1	21	0	249,666	387	9	1	0	8	26,702	46
Manitoba	4	0	0	4	0	7,406	18	3	0	0	3	4,876	6
British Columbia	8	5	1	2	0	44,395	87	1	0	0	1	7,988	50
Northwest Territories	0	0	0	0	0	0	15	0	0	0	0	0	15

Central Pecos County wildcat completed in Ellenburger

An Ellenburger gas discovery was completed 23 miles southeast of Fort Stockton in central Pecos County, West Texas.

The well is Hassie Hunt trust 2 H. A. Wimberly in Section 40, Block 1, I&GN Survey. It flowed 2,675 M.c.f.d. with tubing pressure of 3,324 psi. Perforations are at 10,480-10,535 ft. Location is 4 miles southwest of Ellenburger production at a recently-completed wildcat discovery 4½ miles northeast of Pickett field.

Rojo Caballos. The third producer in this Pecos field was completed flowing 3,384 M.c.f.d. from Pennsylvanian perforations at 15,122-15,205 ft. The well is Mobil Oil Co. 1 Ida Weatherby, ½-mile east extension to the field. Location is in Section 20, Block 48, T-8, T&P Survey.

August Wildcat Completions Rise to 800

	Total	Oil	Cond.	Gas	Dry	Footage	Cum. 1961	Cum. footage 1961
Alabama	0	0	0	0	0	0	7	76,219
Alaska	3	0	0	1	2	30,912	6	60,072
Arizona	2	1	0	0	1	6,772	10	29,676
Arkansas	13	0	0	1	12	54,707	69	276,649
California	17	0	0	2	15	109,351	172	1,091,791
Colorado	21	2	0	1	18	109,401	191	933,977
Florida	0	0	0	0	0	0	7	68,620
Georgia	0	0	0	0	0	0	1	4,500
Illinois	66	10	0	0	56	153,074	294	566,618
Indiana	19	2	0	1	16	27,534	127	164,568
Kansas	67	2	0	2	63	269,169	631	2,489,785
Kentucky	6	2	0	0	4	5,781	91	122,367
Louisiana	58	2	0	1	55	497,149	398	3,450,463
North	25	1	0	0	24	92,903	171	754,915
South	29	1	0	1	27	351,373	190	2,274,982
Offshore	4	0	0	0	4	52,873	37	420,566
Michigan	29	2	0	1	26	91,379	184	570,753
Mississippi	18	2	0	0	16	173,705	125	1,248,685
Missouri	4	0	0	0	4	5,538	30	57,575
Montana	15	0	0	0	15	72,857	117	625,030
Nebraska	54	5	0	0	49	241,928	330	1,531,594
Nevada	1	0	0	0	1	400	13	19,643
New Mexico	20	2	0	0	18	107,961	197	1,051,417
West	8	1	0	0	7	38,459	64	193,052
East	12	1	0	0	11	69,502	133	850,365
New York	0	0	0	0	0	0	12	38,630
North Dakota	5	1	0	0	4	34,391	45	306,504
Ohio	6	1	0	1	4	15,400	33	108,707
Oklahoma	41	8	0	3	30	252,469	385	2,060,215
Oregon	0	0	0	0	0	0	2	15,295
Pennsylvania	3	0	0	1	2	18,914	34	227,946
South Dakota	2	0	0	0	2	13,165	5	30,908
Tennessee	20	0	0	1	19	19,776	62	47,102
Texas	285	42	3	10	230	1,556,288	2,037	10,226,488
District 1	41	4	1	1	35	145,033	242	823,395
District 2	26	2	1	1	22	168,030	148	1,003,074
District 3	16	2	0	1	13	162,856	148	1,377,781
District 4	22	3	1	2	16	129,271	191	1,105,793
East (5 & 6)	32	0	0	0	32	196,048	209	1,055,682
District 7-B	41	7	0	0	34	144,474	335	1,177,922
West (7-C & 8)	64	17	0	0	47	351,657	516	2,470,787
District 9	29	4	0	1	24	138,789	180	698,783
District 10	14	3	0	4	7	120,130	68	513,271
Utah	5	1	0	0	4	31,313	73	411,236
Washington	0	0	0	0	0	0	7	25,715
West Virginia	1	0	0	0	1	10,805	6	50,311
Wisconsin	0	0	0	0	0	0	6	8,100
Wyoming	19	1	0	1	17	117,022	232	1,260,699
Total August 1961	800	86	3	27	684	4,027,161	5,939	29,251,858
Total July 1961	730	71	9	42	608	3,802,875		
Cumulative 1961	5,939	532	62	266	5,079	29,251,858		
Cumulative 1960	6,462	563	71	213	5,615	29,980,917		

Borden County. Midwest Oil Corp. completed a new-pool opener at 1 L. C. Drum in northeastern Borden County, 16 miles northeast of Gail in Section 467, Block 97, H&TC Survey, 1½ miles east of Seven "J" field. It flowed 121 bbl. of 39°-gravity oil per day plus 8 bbl. water on a 11-hour potential test through 8/64-in. choke from perforations in the Ellenburger at 8,374-76 and 8,380-82 ft.

Upton County. Blue Danube Oil Co. completed 1 H. F. Neal, 1½ miles northeast of Rankin, flowing 239 bbl. of oil in 9 hours on 16/64-in. choke, or 637 bbl. daily, to open new Strawn Pennsylvanian production. Perforations were at 9,336-42, 9,356-64, and 9,379-90 ft. Operator will dually complete in the Ellenburger. New field name requested is Harry Miller-Strawn. Location is in Section 26, Block B, HE&WT Survey, 7 miles northwest of Box Block 4-Multipay field.

Panhandle well flows gas from lower Morrow pay

A lower Morrow Pennsylvanian gas well was completed in southeastern Ochiltree County to add new production to the Ellis Ranch area. Sinclair Oil & Gas Co. 1 Laura Jones Gas unit, Section 488, Block 43, H&TC Survey, 14 miles southeast of Perryton and 1½ miles southwest of basal Morrow gas in Ellis Ranch, flowed 13,800 M.c.f.d. on absolute open-flow potential from perforations at 9,019-56 ft.

Two pays produce in Texas Wilcox discovery

A dual Wilcox discovery has been made by Sinclair Oil & Gas Co. in the southeast corner of Tyler County, in southeastern Texas.

The discovery well, 1 Kirby (117 Hardin), is 1½ miles northeast of Jackson-Doty field, across the line in northeastern Hardin County. It is 3 miles southeast of the town of Fred.

Its Wilcox pays are perforated at 9,016-26 ft., and 9,067-79 ft. and 9,090-96 ft.

The first-zone is rated good for 7,380 M.c.f. of gas (absolute open-flow) daily. Shut-in top pressure is 2,768 psi. Gas-liquid ratio is 6.6 M.c.f. per barrel. Gravity of the liquid is 54°.

The Products Pipe Lines map in this issue shows the location of Underground LPG storage areas.

35 OF THE 38

mined storage caverns were engineered and constructed by

FENIX & SCISSON
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WILMINGTON TRUST BLDG., WILMINGTON, DEL.

Absolute open-flow potential of the second zone is 1,180 M.c.f. of gas daily with gas-liquid ratio of 8.9 M.c.f. per barrel. Shut-in pressure is 2,635 psi.

Sinclair's second test on the 2,992-acre lease is a half mile southeast on the county line.

Garza County, Texas' Kirkpatrick field gains second well

The second producer in newly opened Kirkpatrick-Pennsylvanian field in Garza County, West Texas, flowed 246 bbl. of 36.3°-gravity oil per day on 10/64-in. choke. It is Shell Oil Co.'s 2 W. M. Kirkpatrick.

Production is from perforations at 7,939-42 and 7,946-54 ft. Location is in Section 3, Block 2, GH&H Survey.

Yoakum County. Humble Oil & Refining Co. 1 Williams-Mabry, an old 12,025-ft. dry hole in the northwest part of the county, 8 miles northwest of Plains, Tex., is now a Wolfcamp Permian discovery.

The well pumped 190 bbl. of 44°-gravity oil plus 24 bbl. water per day from perforations at 8,955-58 ft. Location of this workover discovery is 2¼ miles northeast of Block D-Devonian field in Section 304, Block D, John H. Gibson Survey. The original hole was drilled by Jake L. Hamon in late 1960.

Coke County. United States Smelting, Refining & Mining Co. completed 1 Burns as a reef discovery in southwestern Coke County.

The well flowed 144 bbl. of 39.6°-gravity oil daily through 16/64-in. choke from perforations at 6,650-66 ft. Location is Section 281, Block 2, H&TC Survey, 10 miles southwest of the Robert Lee Survey and 5 miles south of I.A.B. field.

Discovery wells

KANSAS

Barton County:
Raymond Oil Co., Inc., 1 Knop, NE NE SW 9-19s-12w. IPP 156 BOPD, no water, 37.1°, Lansing 3,326-31 ft. TD 3,436 ft. New oil discovery.

Marion County:
Benedict Oil Assoc. et al. 1 Bartell, NE NW SE 36-19s-2e. IPP 8 BOPD, Miss. 2,512-14 ft. TD 2,867 ft. New oil discovery.

MISSISSIPPI

Jones County:
Triad Oil & Gas Co. 1 E. S. Cambrell, 34-10n-14w. IP 275 BOPD, 24/64-in., 19°, TP 90 psi., GOR 300 cu. ft. per bbl., perf. 9,474-78 ft., Washita- Fredericksburg. TD 12,502 ft. Discovery well of Summerland field.

NEBRASKA

Dundy County:
Sterling Drilling Co. 1 Dunn, SE NE 31-3n-36w. IPP 102 BOPD (net), 4 to 6% water, perf. 3,824-63 ft., Admire zone. TD 5,212 ft. New-field discovery.

Frontier County:
Blair & Associates and Murfin Drilling Co. 1 Zimmer, C NW SW 33-6n-30w. IPP 12 BOPD and 12 BWPD, perf. 4,230-35 ft., basal Kansas City. TD 4,260 ft. New-field discovery.

Kimball County:
Gage Oil & Gas Co. 1 Lobb, SE NW 28-15n-55w. IPP 150 BOPD, "J" sand 6,146½-49½ ft. TD 6,220 ft. "J" sand discovery, new field.

Red Willow County:
K&E Drilling Co. 1 Bastian-B, C NE NW 12-1n-28w. IPP 45 BO, 13 BWPD, Lansing-Kansas City 3,313-25 ft. TD 3,634 ft. Lansing-Kansas City discovery, new field.

NEW MEXICO

Eddy County:
Curtis Hankamer 1 Gulf, 15 miles southeast of Malaga in Sec. 34-26s-29e. IPP 27 BOPD plus 41 BWPD, 10/64-in. choke, Delaware 2,899-2,905 ft. open hole. TD 2,905 ft. New oil discovery.

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▸▸▸ Personals

A. J. Field, vice president and general manager of Global Marine Exploration Co., Los Angeles, has been elevated to executive vice president of the contract drilling and engineering firm. Three new members have been added to the company's board. All are officials of Aerojet - General Corp., which recently bought 45% interest in Global Marine. The new directors are **Dan A. Kimball,** president of Aerojet; **K. F. Mundt,** vice president, manufacturing; and **R. I. McKenzie,** treasurer. Field was one of the organizers of CUSS offshore group in 1953 and was named general manager of Global Marine when the company was organized in 1958. He was with Union Oil Co. before joining the CUSS group.

FIELD

Douglas M. Pogue, chief systems analyst, oil and gas, for Daystrom, Inc., in La Jolla, Calif., has joined Continental Oil Co. as senior production engineer in Morgan City, La.

Glenn St. Aubyn has joined J. M. Huber Corp.'s oil and gas division as manager of the new Calgary district office. **Lee Ira Meador,** formerly chief geologist for Canada Southern Petroleum, has been named district geologist for Huber.

Dr. Paul P. Reichertz, manager of production research and applied mathematics at Socony Mobil Oil Co.'s Dallas field research laboratory, has been named manager of the laboratory. He succeeds **Dr. Ivan Alexander,** manager since 1956. Alexander has joined Socony's Mobil Petroleum division to work with details of the division of Standard-Vacuum interests between Socony and Standard Oil Co. (N. J.). **Dr. Carl S. Kuhn,** assistant manager of the Dallas lab's production research division, will succeed Reichertz as manager of this division. **Baird Elfrink** has been named manager of the production technical-service division, a new post at the lab.

Robert O. Jennings has been named a vice president of Signal Oil & Gas Co. He will continue as general manager of crude-oil purchases and sales and supply and transportation. Jennings joined Signal last year after several years as an independent consultant. He was manager of supply and distribution for Gulf Oil Corp. before becoming a consultant.

John W. Stephenson, district engineer for Tidewater Oil Co. in Robinson, Ill., has been named acting supervisor of a Tidewater special-study group in Ventura, Calif.

Dr. Henry R. Linden, research director of Institute of Gas Technology, has been appointed director of the institute. He succeeds **Dr. Martin A. Elliott,** now academic vice president of Illinois Institute of Technology. Linden was with Socony Mobil Oil Co. before joining Institute of Gas Technology in 1947.

Gardiner Symonds, board chairman of Tennessee Gas Transmission Co., has taken over the additional duties of president of Tenneco Oil Co., Tennessee Gas subsidiary for exploration, production, refining, and marketing. **R. C. Graham,** who became president of Tenneco Oil last December when Tennessee Gas' corporate structure was reorganized, has been named vice chairman of the board for Tenneco Oil. Symonds is chairman.

SYMONDS

Dr. Parke A. Dickey, manager of Jersey Production Research Co.'s geological division in Tulsa, has resigned to join the University of Tulsa faculty as head of the department of geology. He succeeds **Dr. Harold E. Enlows,** who has stepped down from the administrative post to devote full time to teaching. Dickey, a former AIME president, has been with the Standard Oil Co. (N. J.) companies for 15 years.

Nelson E. Trumbull, senior planning associate in Ohio Oil Co.'s forward-planning division, has been named president of Marathon Pipe Line Co., Ohio subsidiary. He also becomes a director of Marathon. Trumbull succeeds **Jack H. Rice,** recently named Ohio Oil vice president of supply and transportation. **Max L. Stanfield,** manager of Marathon's Rocky Mountain region, has been named vice president and a director of the company. He will be in charge of operations with headquarters in Findlay, Ohio. Trumbull has been with Ohio Oil since 1936. He had been senior planning associate since 1959. Stanfield has been with the company since 1938.

TRUMBULL

Roy A. Wilson, geophysicist for Esso Argentina in Buenos Aires, has been transferred back to the United States as geophysicist for Humble in New Orleans.

Whelan W. Klemme, chief chemist for Monsanto Chemical Co.'s Anniston, Ala., plant, has been named chief chemist of the Chocolate Bayou project near Alvin, Tex.

Paul V. Ames, formerly with Vitro Chemical Co., has joined Cosden Petroleum Corp.'s polystyrene marketing staff as sales manager for the eastern region. **William R. Claypoole** is Cosden's central region polystyrene sales manager in Akron, Ohio.

Stewart Barnes has returned to Standard Oil Co. (Ohio) after almost 5 years on loan to the Iranian consortium. He had been administrative assistant to the Abadan refinery general manager in Iran. Barnes now is staff assistant in Ohio Standard's Cleveland marketing department. **Robert F. Paulus,** also on assignment with the consortium, has returned to Ohio Standard as chief field construction engineer in refinery engineering. He will work with isocracker construction at the Toledo refinery. In Iran, Paulus was assistant to the construction manager of the Abadan refinery.

▶▶▶ Personals

W. M. Elmer, president of Texas Gas Transmission Corp., Owensboro, Ky., was elected president of Independent Natural Gasoline Association of America at the group's annual meeting in Houston last week. He succeeds **W. E. Mueller,** president of Colorado Interstate Gas Co. The association also elected **Larry Gall** as executive secretary. Gall has been acting secretary since **John Ferguson** retired to the post of consultant last May.

ELMER

James W. Knowles, district superintendent in Alberta Gas Trunk Line Co.'s foothills division, has been promoted to assistant pipeline superintendent for the Trunk Line system. He will continue to headquarter in Calgary. Knowles has been with Trunk Line since 1957.

Theo Bell has been named district superintendent in Andrews, Tex., for Humble Pipe Line Co. He succeeds **Henry H. Qualls,** recently named superintendent of the new Abilene, Tex., district.

Ernest H. Hundertmark has been promoted to senior engineer, gas measurement and regulation, for Peoples Natural Gas Co. He will headquarter in Pittsburgh.

Robert G. Pitcher has joined Mountain Crude Marketers, Denver, as Montana representative. He will headquarter in Billings. Pitcher had been with Humble's exploration department in Billings.

Dr. L. L. Handy has been named a research associate at the La Habra, Calif., laboratory of California Research Corp. **E. L. Dougherty** has been named supervising research engineer in the oil-recovery section, La Habra, and **C. E. Johnson, Jr.,** has been named supervising research chemist, oil-recovery section. At the Richmond, Calif., laboratory of Cal Research, **R. E. Williams** has been named senior research engineer.

Willard E. Rubarts, geologist with Humble in Denver, has been transferred to Salt Lake City in the same capacity.

Dr. Kendall A. Keenmon, senior geologist with Shell Oil Co. in Oklahoma City, has been transferred to Shell Development Co. in Houston as senior geologist.

William G. Cutler, assistant drilling superintendent for El Paso Natural Gas Co. in El Paso, Tex., has been promoted to area production manager, engineering, in Farmington, N. M.

J. B. Ladd, vice president and secretary of Consolidated Oil & Gas, Inc., has been elected executive vice president. **R. B. Tenison** has been named vice president in charge of drilling and production. **C. J. Cooper, Jr.,** has been promoted to secretary and **H. C. Gutjahr** has been named assistant secretary-treasurer.

L. T. Weger, assistant manager of the crude-oil purchase and sales division in Ohio Oil Co.'s supply and transportation organization, has been named manager of the commercial and special-products sales department, marketing. He succeeds **A. D. Lodge,** recently named an international sales representative. Weger has been with Ohio since 1926.

Earl K. Roberts has been promoted to director of merchandising, a new position for Continental Oil Co. He will continue to headquarter in Houston. **T. K. Kennedy,** sales development manager for the Kansas City division, will succeed Roberts as assistant director of sales training in Houston.

Philip Oxley has joined Signal Oil & Gas Co. as Gulf Coast exploration manager. He will headquarter in Houston. Oxley recently resigned as offshore district geologist for Tenneco Oil Co. He had been with Tenneco since 1957 and was with The California Co. in New Orleans before that time.

Bryan O. Keathley, land man with Continental Oil Co., has been transferred to Abilene, Tex., from Los Angeles.

Bill Heck, formerly with Chambers & Kennedy in Midland, Tex., has resigned to form The Exploration Group, consulting and exploration firm in Midland.

Leo R. Newfarmer, Shell Oil Co. Houston, and **Robert E. Rettger,** Sun Oil Co., Dallas, have been nominated for 1962-63 president of American Association of Petroleum Geologists. Election will be by mail ballot and new officers will take over March 29, 1962, at the close of the AAPG annual meeting. Other nominees are, for vice president,

NEWFARMER

RETTGER

Orlo E. Childs, Phillips Petroleum Co., Denver; **John A. Downing,** Link, Downing, Cooke & Co., Ltd., Calgary; and **John M. Hills,** Midland, Tex., consultant. Candidates for secretary-treasurer are **Jackson M. Barton,** Northern Natural Gas Producing Co., Omaha, Neb.; **Robert E. King,** American Overseas Petroleum, Ltd., New York; and **Irving T. Schwade,** Richfield Oil Corp., Los Angeles. **Grover E. Murray,** Louisiana State University, Baton Rouge, is candidate for editor.

L. M. Stevens, Farmington, N. M., district engineer for Aztec Oil & Gas Co., has been transferred to the Dallas home office as staff petroleum engineer. **Ben H. Mears,** petroleum engineer in the Farmington district will succeed Stevens as district engineer. **Billy Perdue,** production foreman, has been transferred from Hobbs, N. M., to Farmington. **Claude Rohrborough,** formerly with Pure Oil Co. in Casper, Wyo., has joined Aztec in Dallas as staff geologist. **Carl E. Jameson** has joined Aztec in Farmington as petroleum engineer and **Robert G. Davis** has joined the Dallas land department.

▶▶▶ Personals

ECK

Franklin E. Eck, marketing manager of chemicals and plastics for Cosden Petroleum Corp., has been named president of Cosden Petrochemical Corp., newly formed subsidiary of Cosden Petroleum. Directors of the new company will be **Kurt P. Duldner, Thomas I. Sheridan, Jr.,** and **Henry W. Parke,** all of New York. Cosden Petrochemical will perform advisory services.

Dr. Frank K. Levin has been appointed a senior research associate by Jersey Production Research Co., Tulsa. Levin has been with Jersey Production and its predecessors since 1949.

E. W. Keefner, chief geologist of Kilroy Co. of Texas, has been elected vice president and special assistant to the president. **Frank Lytle, A. W. Smith, Kenneth Nelson,** and **Donald Schiele** have been assigned to the Houston office as geologists.

R. L. Rayl has been promoted to division exploration geologist for Phillips Petroleum Co. in Denver. He succeeds **A. Haig,** who recently was transferred to Bartlesville, Okla.

W. Fleming Browning, Shell Oil Co., Jackson, Miss., has been elected secretary of Mississippi Geological Society. He succeeds **A. T. Ricci,** Mobil Oil Co., who has been transferred to Shreveport, La.

William F. Wolff has been named senior research scientist in the research and development department of American Oil Co.'s Whiting, Ind., laboratory. **Robert E. Malec** has been named project chemist in the department.

Thell C. Woods, process superintendent for the Cushing, Okla., refinery of Kerr-McGee Oil Industries, Inc., has been named manager of products movements, forecasts and purchases in Oklahoma City. He succeeds **E. Odell Campbell,** who has been named administrator of the company's metallurgical research laboratory in Golden, Colo.

Allen Coxen, geologist with Phillips Petroleum Co., has been transferred from Oklahoma City to Evansville, Ind.

Edward F. Murray, Jr., geophysicist for Superior Oil Co., has been transferred to Midland, Tex., from Oklahoma City.

Dr. John J. Kolfenbach has been promoted to assistant director of the special projects unit for Esso Research & Engineering Co., Linden, N. J.

L. P. Jones, Houston division sales manager for United Gas Corp., has been promoted to general sales manager with headquarters in Shreveport, La.

John M. Allard has been named sales manager for the Baltimore-Washington area of Ashland Oil & Refining Co.'s refinery - sales division. He has moved to Baltimore from Buffalo.

T. F. Lighthouse, head of the treating department at Texaco's Port Arthur, Tex., refinery, has been promoted to assistant superintendent of manufacturing. He succeeds **R. N. Ludwig,** now superintendent of shipping at the refinery.

REED

Robert G. Reed III, assistant general manager of Tidewater Oil Co.'s eastern division in New York, has been named marketing manager of the company. He will headquarter in Los Angeles. Reed succeeds **Don T. Whalen,** now on assignment in the Pacific Northwest.

New research engineers at California Research Corp.'s Richmond, Calif., laboratory include **Donald C. Kendall, Douglas A. Smith, Robert A. Wakefield, Frederick A. Pettersen,** and **Dennis Rohan. Robert W. Campbell** and **Ginny Shen** have been named research chemists, Richmond, and **Ruth L. Hinkins** will be research mathematician there. **Henry R. Slagle** has joined the La Habra, Calif., laboratory as research engineer.

P. E. Goth, manager of Phillips Petroleum Co.'s Shreveport, La., supply division, has been named manager of the supply division office in Amarillo, Tex. He will be responsible for acquisition of crude oil and condensate in the Panhandle area, including the area served by Phillips Pipe Line Co.'s new system from Camrick field in Beaver County, Oklahoma, to the refinery in Phillips, Tex. Goth has been with Phillips since 1946. He had been Shreveport supply division manager since 1956. The Shreveport division is being closed.

F. B. Ingram, executive vice president of Ingram Oil & Refining Co., has been elected a director of Murphy Corp. Ingram Oil & Refining was merged into Murphy September 12. Ingram is president of Ingram Barge Co., which was not included in the merger.

Bryant C. Ross has been named field-sales manager in Pennsalt Chemicals Corp.'s rubber-chemicals department. **Paul J. Schwert** has been named product-sales manager in the department, and **Daniel W. Yochum** has been named manager of the rubber technical-service laboratory.

M. R. Smith, area production engineer for Gulf Oil Corp. in Monahans, Tex., has been named district engineer in the Denver production district office. He succeeds **W. E. Bauman,** who has been named area production manager in Amarillo, Tex.

C. L. Orr, assistant general manager in charge of plants and construction for Texas Gulf Sulphur Co., has retired after more than 41 years with the company. He had been assistant general manager of plants and construction since 1953, and had also served as chief operating engineer, power-plant manager, and assistant manager of new developments.

Personals

Arthur G. Meck, area supervisor in Watson, Calif., for Tidewater Oil Co.'s western division pipeline system, has been named manager of the eastern division pipeline department. He will headquarter in New York. Meck joined Tidewater in 1947. He was named supervisor in Watson in 1958.

Thomas R. Smith, district engineer for Humble in Great Bend, Kans., has been promoted to area production engineer in Mattoon, Ill.

Robert E. Murphy, Mobil Oil Co.'s district geologist in Roswell, N. M., has been transferred to Midland, Tex., as division staff geologist.

Charles A. Walsh, Jr., manager of Atlantic Refining Co.'s retail marketing division in Philadelphia, has been named sales manager of the New York region. He will headquarter in Syracuse.

Don Guertin has been named assistant director of Esso Research & Engineering Co.'s analytical-research division. **Ralph Brown** has been named research associate in analytical research.

Thomas D. Badgwell, junior exploitation engineer with Shell Oil Co. in Midland, Tex., has completed a year's training program and has been appointed exploitation engineer in Abilene, Tex.

I. R. Gardescu, vice president of H. Zinder & Associates, Houston consulting firm, has been named director of the geological division. **Tom L. Kister** will succeed Gardescu as manager of the Houston office.

Thomas F. McCormick, executive assistant to Tidewater Oil Co.'s western division manufacturing manager, has been named administrative assistant to **James McDonald,** western division vice president and general manager.

Edward T. Herndon, a senior partner of Eastman, Dillon, Union Securities & Co., has been elected a director of Mission Development Co.

Richard S. Johnson, petroleum engineer for Honolulu Oil Corp. in Cody, Wyo., has joined Rocky Mountain Natural Gas Co. as area manager in Glenwood Springs, Colo.

Richard Muhlberger has been transferred by Mobil Oil Co. from Allentown, Pa., to Buffalo, N. Y., where he will be an area manager. Muhlberger succeeds **William H. McCarthy,** now retail-programs manager of Mobil's Detroit division.

O. F. Minor, D. C. Marschner, and **A. T. Bartlett** have retired from Shell Oil Co.'s New York marketing department. Minor was manager of the retail department, Marschner was manager of consumer research, and Bartlett, manager of marketing planning and analysis. **J. L. Minner,** manager of the fuel oil-LPG department in New York, has been given a special assignment until his retirement.

Dr. W. F. James, Toronto, and **G. Harry Thompson,** Calgary, have been elected directors of Home Oil Co., Ltd. James is a director of several eastern mining and investment corporations and is also vice president and director of Alminex, Ltd., a company which has been associated with Home Oil in Alberta exploration. Thompson is president of Calgary Power, Ltd. and vice president and a director of Montreal Engineering, Ltd.

Dr. L. C. Gibbons, supervisor of the chemistry department at Ohio Oil Co.'s Littleton, Colo., research center, has been promoted to associate research director there. He will be responsible for refining and petrochemical research and for technical services to company departments involved in these fields. Other technical research activities at the Littleton center have been reorganized. Under the new set up, **Dr. R. D. Russell,** geology department supervisor, will be manager of the new geology and geochemistry department. **R. B. Rice,** physics department supervisor, will be manager of the new physics and mathematics department, and **Dr. F. H. Poettmann,** engineering department supervisor, will be engineering and chemistry department manager.

GIBBONS

N. C. (Nick) Elmer, Casper, Wyo., consulting geologist, has joined Trigood Oil Co. in Casper as geologist.

Lowell Ballinger has been promoted from staff engineer to senior staff engineer at Humble's Bayway refinery, Linden, N. J.

W. H. Medary, Lafayette, La., district exploration superintendent for Tenneco Oil Co., has been promoted to southeastern division exploration superintendent with headquarters in Lafayette.

Deaths

V. E. Hanson, 75, retired construction engineer with Lummus Co., died September 13 at his home in Tulsa. Hanson, who retired in 1953, had supervised refinery construction in Russia, England, Venezuela, the West Indies, and the U. S. He was chief engineer for Midwest Refining Co. in Casper, Wyo., before joining Lummus.

Hardie L. (Jack) Wheeler, 55, supervisor of Service Pipe Line Co.'s communications system, died September 16 in a Tulsa hospital.

Edward S. Bigelow, 63, a market analyst for Minneapolis-Honeywell Regulator Co.'s Brown Instruments division, died September 5 after a long illness. He joined Minneapolis-Honeywell in 1944.

Robert C. Hill, 44, former Boulder, Colo., petroleum engineer, died September 15 in Dallas after a heart attack. Hill moved to Dallas from Boulder last month. He had headed his own consulting firm since 1954 after many years with Eastman Oil Well Survey Co.

Natural gas was the growth fuel of the fifties

BY JOHN C. CASPER

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,153,490	DOWN	17,335	UP	194,430
Crude stocks	244,659,000	DOWN	3,910,000	UP	16,872,000
Completions	889	UP	4	DOWN	48
Refinery runs	7,241,000	DOWN	1,231,000	DOWN	842,000
Gasoline stocks	187,719,000	DOWN	3,488,000	DOWN	1,729,000
Kerosine stocks	35,300,000	DOWN	229,000	UP	596,000
Distillate stocks	160,855,000	UP	3,293,000	DOWN	1,918,000
Residual stocks	49,430,000	DOWN	202,000	UP	1,797,000
Four-product stocks	433,304,000	DOWN	626,000	DOWN	1,254,000
Total imports	1,693,400	DOWN	51,900	UP	81,900

NATURAL GAS was available to residential and commercial customers in 47 states last year, according to the annual gas report by the Bureau of Mines. Gas was not distributed in Maine, Vermont, or Hawaii.

Back in 1950, gas was unavailable in 13 states, including 9 on the East Coast. Movement of natural gas into the thickly populated areas of the East Coast has been an important factor in the outstanding expansion of gas sales.

Commercial and residential sales in District 1 grew from 784 M.M. c.f.d. in 1950 to 2,827 M.M.c.f.d. in 1960. This expansion represents a net gain of 260.5%.

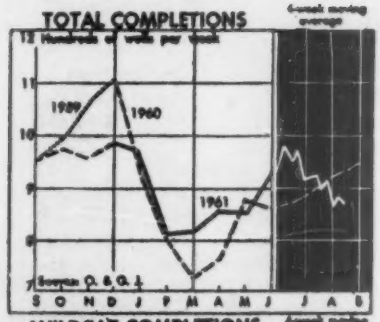
The volumetric increase on the East Coast was topped only by the gain in District 2 where gas had been available for many years. The 10-year gain for District 2 was 3,126 M.M.c.f.d.

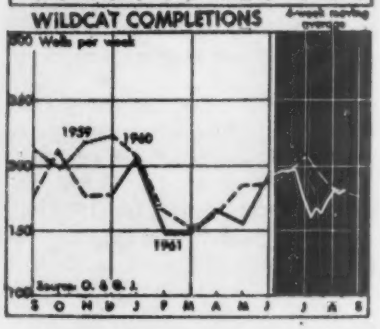
For the country as a whole, residential and commercial sales showed larger percentage gains in the first 5 years of the fifties than in the last, but volumetric gains were much larger in the last half. Relative gains were 73.6% for 1950-55 and 49.4% for 1955-60.

On a volumetric basis, sales increased 3,197 M.M.c.f.d. in the first half of the decade and 3,725 M.M. c.f.d. in the last. This big volumetric gain was more important than percentage gains in measuring competition between gas and distillate fuel. Oil or gas energy is based on volume.

Residential and commercial sales of natural gas (M.M.c.f.d.)

	1950	1955	1960	Per cent inc. 1955 over 1950	Per cent inc. 1960 over 1955
District 1					
Connecticut	....	27.7	52.4	....	89.2
Delaware	....	6.1	12.0	....	96.7
Dist. of Col.	25.0	39.1	47.1	56.4	20.5
Florida	3.0	6.1	36.5	103.3	498.4
Georgia	63.2	122.0	211.0	93.0	73.0
Maine	....	....	....	....	....
Maryland	30.7	85.0	133.9	176.9	57.5
Massachusetts	....	80.6	151.0	....	87.3
New Hampshire	....	3.1	6.0	....	93.5
New Jersey	9.7	130.6	233.5	1,246.4	78.8
New York	150.0	514.3	785.8	242.9	52.8
North Carolina	....	10.6	33.5	....	216.0
Pennsylvania	363.9	564.6	787.4	55.2	39.5
Rhode Island	....	12.7	23.0	....	81.1
South Carolina	....	7.3	31.4	....	330.1
Vermont	....	....	....	....	....
Virginia	16.7	59.6	104.5	256.9	75.3
West Virginia	121.9	153.1	178.1	25.6	16.3
Total Dist. 1	784.1	1,822.5	2,827.1	132.4	55.1
District 2					
Illinois	214.6	424.5	763.3	97.8	79.8
Indiana	59.3	149.3	262.4	151.8	75.8
Iowa	71.1	149.0	235.8	109.6	58.3
Kansas	178.5	243.1	313.3	36.2	28.9
Kentucky	92.1	146.0	222.0	58.5	52.1
Michigan	236.9	396.4	669.3	67.3	68.8
Minnesota	86.0	157.1	223.4	82.7	42.2
Missouri	168.9	264.8	392.9	56.8	48.4
Nebraska	77.3	127.8	167.8	65.3	31.3
North Dakota	7.7	11.6	18.2	50.6	56.9
Ohio	582.1	915.1	1,283.5	57.2	40.3
Oklahoma	158.0	200.2	242.1	26.7	20.9
South Dakota	14.8	22.6	40.7	52.7	80.1
Tennessee	47.5	106.7	158.8	124.6	48.8
Wisconsin	31.6	81.4	159.3	157.6	95.7
Total Dist. 2	2,026.4	3,395.6	5,152.8	67.6	51.7
District 3					
Alabama	43.4	99.6	159.3	129.5	59.9
Arkansas	63.0	89.1	137.8	41.4	54.7
Louisiana	96.6	146.6	216.6	51.8	47.7
Mississippi	43.9	74.7	107.1	70.2	43.4
New Mexico	37.0	50.3	80.3	35.9	59.6
Texas	326.8	486.6	632.2	48.9	29.9
Total Dist. 3	610.7	946.9	1,333.3	55.1	40.8
District 4					
Colorado	91.2	135.8	220.7	48.9	62.5
Idaho	....	....	220.7	....	....
Montana	55.5	68.2	78.7	22.9	15.4
Utah	28.2	53.4	89.4	89.4	67.4
Wyoming	26.7	38.9	37.5	45.7	−3.6
Total Dist. 4	201.6	296.3	439.9	47.0	48.5
District 5					
Alaska	....	....	0.5	....	....
Arizona	32.4	52.2	144.0	61.1	175.9
California	690.6	1,026.6	1,294.2	48.7	26.1
Nevada	....	2.8	7.7	....	175.0
Oregon	....	....	27.0	....	....
Washington	....	....	39.6	....	....
Total Dist. 5	723.0	1,081.6	1,513.0	49.6	39.9
Total U. S.	4,345.8	7,542.9	11,266.1	73.6	49.4





Active Rotary Rigs

	9-18-61	9-11-61	9-19-60
Alabama	5	6	3
Alaska	14	13	7
Arkansas	13	12	13
Arizona	1	0	1
California	90	78	81
Land	87	75	78
Offshore	3	3	3
Colorado	30	29	51
Florida	2	2	1
Land	0	0	1
Offshore	2	2	0
Illinois	55	48	50
Indiana	13	14	7
Iowa	1	1	0
Kansas	95	97	120
Kentucky	4	6	5
Louisiana	269	277	284
North	38	41	36
S. Inland waters	96	96	112
S. Land	81	81	82
Offshore	54	59	54
Michigan	26	27	36
Mississippi	62	70	51
Missouri	1	1	2
Montana	23	21	25
Nebraska	26	21	21
Nevada	0	0	2
New Mexico	100	95	105
New York	1	1	2
North Carolina	1	1	0
North Dakota	14	12	14
Ohio	9	9	6
Oklahoma	216	215	170
Oregon	0	0	1
Pennsylvania	10	10	8
South Dakota	0	0	1
Tennessee	1	0	0
Texas	628	664	616
S. Inland waters	11	9	3
S. Land	174	189	174
Offshore	1	1	1
North	50	49	43
Panhandle	56	63	49
East	59	65	56
West Central	159	164	174
West	118	124	116
Utah	40	37	29
Washington	1	1	1
West Virginia	12	12	6
Wisconsin	1	1	0
Wyoming	64	67	69
Total U. S.	1,828	1,848	1,788
Cum. avg. to date	1,712	1,709	1,731
Western Canada	151	148	135
Eastern Canada	2	2	0
Grand total	1,981	1,998	1,923

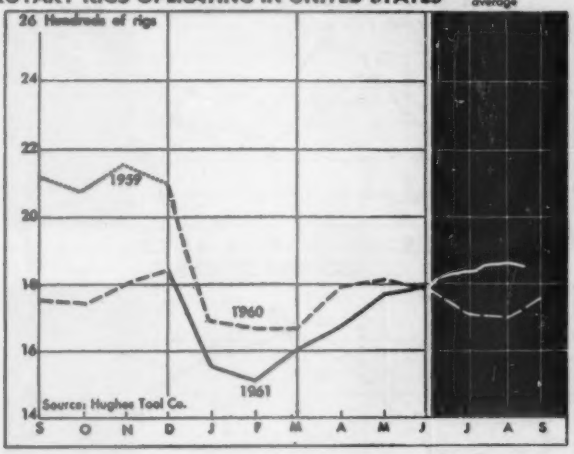
Hughes Tool Co. report.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 16, 1961

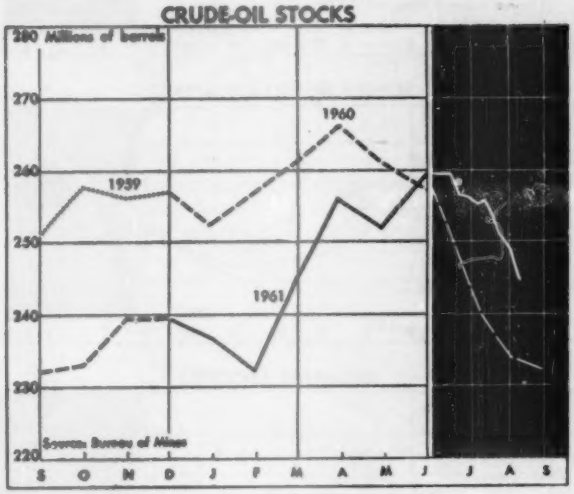
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Alabama	0	0	0	0	0	0	0	31	33	0	0	0	0	0	7	2
Alaska	0	0	0	0	0	0	0	30	. . .	0	0	0	0	0	6	. . .
Appalachian	91	29	0	37	8	17	208,851	1,525	1,251	2	0	0	0	2	54	47
Arizona	1	1	0	0	0	0	5,792	18	28	0	0	0	0	0	10	18
Arkansas	11	3	0	1	7	0	40,430	362	425	5	0	0	0	5	80	114
California	32	16	0	3	11	2	127,361	1,205	1,153	7	1	0	1	5	188	220
Colorado	21	7	0	2	12	0	104,236	440	453	7	0	0	0	7	201	227
Illinois	39	18	0	0	19	2	93,653	1,430	1,591	12	4	0	0	8	318	325
Indiana	17	5	0	0	12	0	29,371	526	745	4	0	0	0	4	137	272
Kansas	103	48	0	6	42	7	221,536	3,572	2,591	15	1	0	0	14	659	740
Kentucky	25	7	0	6	8	4	41,177	1,371	1,449	3	2	0	0	1	94	125
Louisiana	113	44	6	9	50	4	824,987	2,715	2,511	11	0	0	0	11	428	392
North	44	19	0	4	17	4	138,176	1,077	939	4	0	0	0	4	186	189
South	41	12	4	4	21	0	402,399	1,234	1,216	5	0	0	0	5	202	178
Offshore	28	13	2	1	12	0	284,412	404	356	2	0	0	0	2	40	25
Michigan	10	3	0	0	7	0	28,716	547	657	3	0	0	0	3	198	169
Mississippi	8	2	1	0	5	0	81,797	381	497	2	0	0	0	2	132	191
Montana	6	2	0	1	3	0	22,408	278	221	2	0	0	0	2	130	105
Nebraska	11	2	0	0	9	0	56,042	712	627	10	1	0	0	9	355	254
New Mexico	37	17	1	10	9	0	188,387	1,270	1,316	9	5	1	0	3	212	198
West	17	5	0	10	2	0	92,637	558	446	1	1	0	0	0	67	50
East	20	12	1	0	7	0	95,750	712	870	8	4	1	0	3	145	148
North Dakota	3	2	0	0	1	0	19,776	184	213	1	0	0	0	1	49	57
Ohio	11	4	0	3	4	0	27,980	728	754	0	0	0	0	0	33	36
Oklahoma	79	33	2	9	31	4	384,623	4,068	3,339	15	2	0	0	13	411	540
Texas	238	121	7	17	89	4	1,068,347	10,276	11,212	63	5	1	4	53	2,173	2,312
District 1	18	2	0	0	16	0	49,748	639	775	11	1	0	0	10	263	291
District 2	13	5	0	4	4	0	66,227	554	553	2	0	0	0	2	154	140
District 3	13	8	2	2	1	0	78,673	818	852	3	1	0	1	1	159	159
District 4	19	1	0	7	11	0	135,160	856	778	10	0	0	2	8	205	222
East	15	4	2	0	9	0	73,940	854	899	6	0	0	0	6	225	186
District 7-B	24	7	1	0	16	0	84,823	1,287	1,641	14	1	0	0	13	362	472
West	59	50	0	0	8	1	303,329	2,552	2,945	7	2	0	0	5	529	455
District 9	51	29	2	0	17	3	139,190	1,872	2,042	6	0	1	0	5	197	344
District 10	26	15	0	4	7	0	137,257	844	727	4	0	0	1	3	79	43
Utah	6	2	0	0	4	0	46,719	172	173	4	0	0	0	4	79	59
Wyoming	22	11	0	3	8	0	114,445	667	746	6	1	0	0	5	251	304
Miscellaneous*	5	0	0	0	5	0	12,081	149	123	5	0	0	0	5	136	102
Total U. S.	889	377	17	107	344	44	3,748,715	32,657	32,108	186	22	2	5	157	6,341	6,809
Prev. week	885	438	14	86	319	28	3,713,330	. . .	. . .	181	18	1	10	152	. . .	. . .
Cum. 1961	32,657	14,612	653	3,221	11,815	2,356	132,163,643	. . .	. . .	6,341	573	65	281	5,422	. . .	. . .
Cum. 1960	32,108	14,588	946	2,616	12,252	1,706	135,060,430	. . .	. . .	6,809	602	76	229	5,902	. . .	. . .
Western Canada	46	25	0	7	12	2	225,123	1,618	1,655	7	1	0	1	5	392	436

*Includes: S. D. 1, Nev. 1, Mo. 3.

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	9-9-61	9-2-61	9-10-60
Pennsylvania	2,411	2,452	2,312
Other Appalachian	1,597	1,438	1,473
Illinois, Indiana, Michigan	10,546	10,791	9,029
Nebraska and North Dakota	3,791	3,577	2,813
Kansas	9,033	9,104	8,658
Oklahoma	16,762	17,012	14,793
Arkansas	1,608	1,827	1,900
Louisiana	19,014	19,628	18,056
North	3,316	3,375	2,975
South	15,698	16,253	15,081
Mississippi, Alabama, Florida	3,476	3,466	1,896
New Mexico	8,691	8,916	7,927
Texas	102,061	105,975	96,918
East Texas	7,797	8,055	7,727
West Texas	45,385	47,679	46,690
Texas Gulf	18,409	18,455	16,101
Other Texas	30,470	31,786	26,400
Wyoming	16,353	16,553	14,403
Other Rocky Mountain	9,892	9,605	9,345
California	23,488	23,690	26,095
Foreign	†15,936	14,535	12,169
Total	**244,659**	248,569	227,787

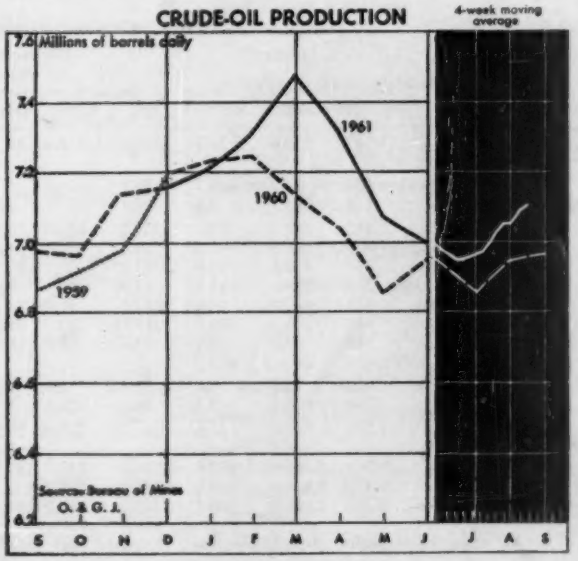
*Bureau of Mines. †Includes 4,666,000 bbl. in California.

DAILY AVERAGE PRODUCTION FOR WEEK

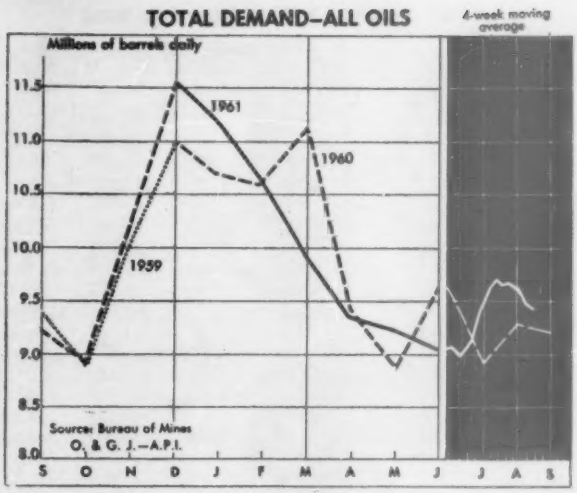
	September 16, 1961			
	Crude oil	Lease condensate	Total	Sept. 9 total
Alabama	17,750	.....	17,750	17,100
Alaska	21,600	.....	21,600	21,500
Arkansas	75,050	150	75,200	75,150
California	812,550	.....	812,550	814,000
Colorado	127,300	.....	127,300	126,800
Eastern	40,000	.....	40,000	40,500
Florida	1,000	.....	1,000	1,000
Illinois	219,800	.....	219,800	214,800
Indiana	30,200	.....	30,200	30,000
Kansas	†298,940	.....	†298,940	†306,375
Kentucky	51,700	.....	51,700	50,900
Louisiana	1,010,000	154,950	1,164,950	1,164,950
North	105,725	5,500	111,225	111,225
South	904,275	149,450	1,053,725	1,053,725
Michigan	52,900	.....	52,900	53,100
Mississippi	146,000	4,000	150,000	150,000
Montana	88,900	.....	88,900	87,000
Nebraska	65,800	.....	65,800	64,000
Nevada	400	.....	400	400
New Mexico	300,500	7,500	308,000	308,000
North Dakota	58,600	.....	58,600	58,800
Oklahoma	†487,000	.....	†487,000	†514,900
Texas	2,490,000	90,400	2,580,400	2,580,400
Dist. 1	43,000	2,700	45,700	45,700
Dist. 2	105,000	8,000	113,000	113,000
Dist. 3	327,000	38,000	365,000	365,000
Dist. 4	181,000	13,000	194,000	194,000
Dist. 5	27,000	650	27,650	27,650
Dist. 6	117,000	8,000	125,000	125,000
East Texas field	129,000	.....	129,000	129,000
Dist. 7-B	129,000	400	129,400	129,400
Dist. 7-C	109,000	3,450	112,450	112,450
Dist. 8	1,022,000	12,000	1,034,000	1,034,000
Dist. 9	194,000	2,500	196,500	196,500
Dist. 10	107,000	1,700	108,700	108,700
Utah	93,200	.....	93,200	85,400
Wyoming	406,700	.....	406,700	405,200
Others	‡600	.....	‡600	‡550
Total U. S.	6,896,490	257,000	**7,153,490**	7,170,825
Change from prev. week, down			**17,335**	
Canada	†668,200	.....	†668,200	†571,200
Total U. S. prod.—Jan. 1-Sept. 16			1,862,869,300 bbl.	
Same period last year (crude plus cond.)			*1,825,994,200 bbl.	

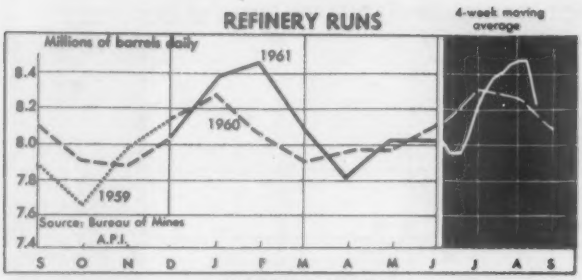
*Includes 58,816,200 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona.

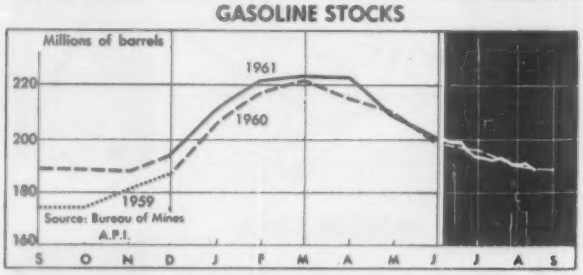
CRUDE-OIL PRODUCTION

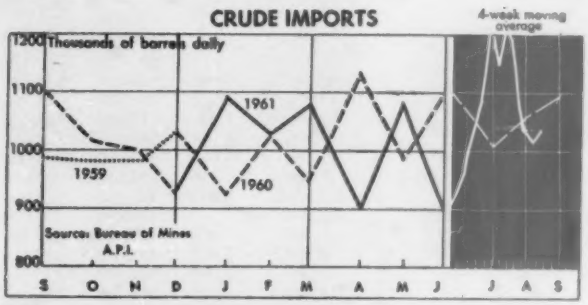


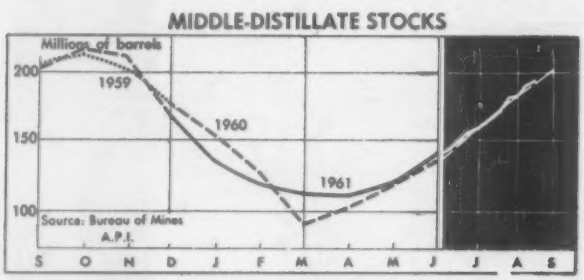
REFINING

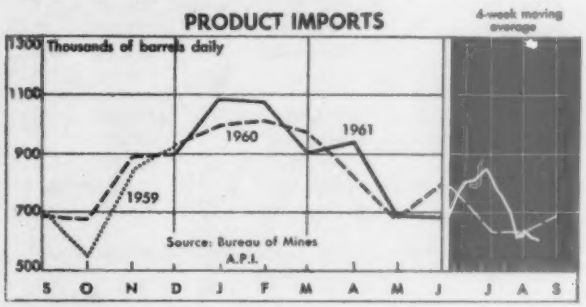


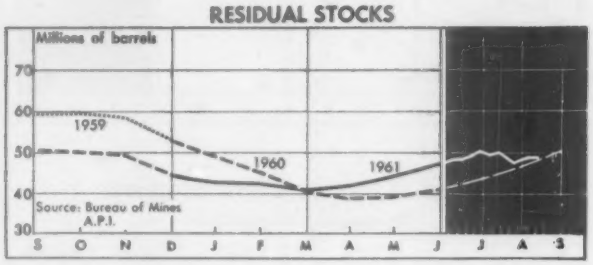












API REFINERY REPORT—SEPTEMBER 15, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.	Stocks‡: Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, September 1960: Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.
East Coast	1,147	529.6	36.7	353.7	136.4	44,793	13,650	57,688	12,796	1,165	510.5	30.7	337.7	131.6
Appalachian:														
District 1	101	42.0	5.7	22.6	8.3	5,214	727	3,748	446	94	41.6	3.3	22.9	6.6
District 2	110	58.3	6.3	20.1	11.3	2,697	457	1,634	309	107	55.3	5.2	20.3	10.3
Ind., Ill., Ky.	1,552	812.3	77.6	319.3	153.4	31,773	7,195	29,886	5,654	1,473	787.3	68.4	318.5	130.9
Minn., Wis., Dak.	130	56.8	7.4	30.1	24.6	6,575	1,762	8,350	653	117	54.3	3.9	28.5	15.6
Okla., Kans., Mo.	731	411.6	12.9	177.4	20.4	17,543	1,945	13,009	1,036	738	415.5	7.9	190.1	19.0
Inland Texas	302	209.1	13.0	53.9	20.3	7,035	710	1,553	2,696	296	231.0	9.6	47.7	21.3
Texas Gulf Coast	887	447.4	40.7	232.3	61.0	24,477	3,726	17,963	5,459	1,850	977.9	125.0	453.7	138.5
La. Gulf Coast	610	371.3	39.6	167.4	35.6	10,376	1,931	5,816	1,088	646	363.8	63.5	147.1	40.1
N. La. and Ark.	113	69.0	7.1	23.4	5.4	6,190	721	2,477	190	108	63.7	7.3	19.5	7.6
Rocky Mountain:														
New Mexico	28	16.3	0.4	3.3	2.9	529	50	237	66	22	11.9	0.3	4.2	2.1
Other	294	136.3	7.3	56.0	34.4	5,356	698	3,042	1,157	294	142.5	2.9	63.5	29.7
West Coast	1,236	585.4	57.9	244.9	293.3	25,161	1,728	15,452	17,880	1,190	544.1	31.2	177.2	306.0
Sept. 15, 1961	7,241	3,745.4	312.6	1,704.4	807.3	187,719	35,300	160,855	49,430	8,130	4,199.4	359.2	1,830.9	859.3
Sept. 8, 1961	§8,472	4,324.6	423.6	1,950.6	828.0	191,207	35,529	157,562	49,632	.....	.....	.....	.....	.....
Sept. 16, 1960	8,083	4,195.0	366.7	1,883.0	815.9	189,448	34,704	162,773	47,633	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines. §Rev.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Okla-homa	West Tex. (sour)	West Tex. (inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Jules-burg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	....	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	†$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague. †Other posting starts at $2.55.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	$4.80
Middle District	4.52
Southwest Pennsylvania	4.35
West Virginia	4.17
Buckeye Grade	4.08
Illinois Basin	**3.00-3.05**

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)	
Arabian, 34.0°-34.9°, Ras Tanura	$1.80
Iranian, 34.0°-34.9°, Bandar Mashur	1.78
Iranian, 34.0°-34.9°, Abadan	1.73
Iraq, 35.0°-35.9°, Fao	
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.59
Qatar, 41°-41.9°, Umm said	1.95
Middle East, E. Mediterranean:	
Arabian, 34.0°-34.9°, Sidon	$2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli	2.19
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 36°	2.42
Canada:	
★ Leduc-Woodbe	$2.63
★ Redwater (Alta.	2.52
★ Weyburn (light)	2.185
Midale C	1.71
Venezuela:	
Cumarebo, 47°-47.9°, Tucupido	3.34
San Joaquin, 40°-40.9°, Puerto La Cruz	3.08
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Price for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long ton)

(Latest reported spot fixtures)

★ Gulf-NY, dirty (ATRS+11.25%)	$3.17
★ Carib.-NY, dirty (ATRS−60%)	1.10
★ Carib.-UK, clean (Scale−28.75%) (23s. 2d.)	3.25
★ PG-UK, dirty (Scale−62.5%) (24s. 2d.)	3.39
PG-Japan, dirty (USMC − 72.5%)	2.81

★ Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★ Regular (91 octane	10.00-10.50
★ Premium (99 octane)	12.75-13.25
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.50-11.00
Regular (92 octane)	10.75-11.25
California (rack) Los Angeles:	
Regular (90 octane)	11.60
Premium (94 octane)	12.60
Premium (100 octane)	14.10
Caribbean area (cargoes):	
Regular (87 octane)	9.00
Premium (97 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-9.75
Diesel oil (58 d.i. and above)	9.00-9.25
Distillate No. 1	9.00-9.25
Distillate No. 2	8.25-8.50
Gulf Coast (cargoes):	
Kerosine 41-43	9.50
Distillate No. 2	8.50
New York Harbor (barges):	
Kerosine 42-43	11.20
Distillate No. 2	10.20
Diesel fuel, 48-52 d.i.	10.35
Caribbean area (cargoes):	
Distillate No. 2	8.10

RESIDUAL FUEL

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.65-1.75
Gulf Coast (cargoes):	
Bunker C fuel	2.20-2.30
New York Harbor (barges):	
Bunker C fuel	2.52
Caribbean (cargoes):	
Bunker C fuel	2.00
California (rack):	
Bunker C fuel, Los Angeles	2.25

Classified Advertising

. . . your market place for the oil and gas industry

RATES:

- UNDISPLAYED CLASSIFIED: 30c a word per issue. 10% discount for three or more consecutive issues. $5.00 minimum charge. Blind box in our care count nine extra words. Not subject agency commission.
- DISPLAYED CLASSIFIED $20 a column inch one issue. 10% discount three or more consecutive issues. Minimum size one inch Subject to agency commission.
- All classified payable in advance.
- DEADLINE: Copy to reach The Oil and Gas Journal not later than 9 a.m. on Wednesday preceding date of publication. Send advertisments to: Classified Advertising Manager, THE OIL AND GAS JOURNAL, P. O. Box 1260, Tulsa 1, Oklahoma.

EXCEPT . . .

WESTERN STATES: (California, Washington, Oregon, Idaho, Nevada, Utah, and Arizona). Write: Classified Departments, Inc., The Oil and Gas Journal, 4041 Marlton Ave., Los Angeles 8, Calif. Phone AXminister 2-0287. Copy deadline Monday noon.

FOR SALE EQUIPMENT

50,000 FT.' 20 inch No. 1 grade used pipe. Lengths 20 ft. square cut ends. Weight 78# to the ft. High Tensile Pipe. Indiana-Ohio Pipe Co., P. O. Box 5462 Shep. Sta., Columbus 19, Ohio. Phone CL 3-5527—CL 3-5528.

USED GAS PROCESSING Equipment: Glycol and Dry Dessicant Dehydrators; Quick-cycle Hydrocarbon Recovery Units; Water Flood Filter-pump Units. Also new oil and gas production equipment. Engineered Specialties Co., P. O. Box 35683, Phone FL 1-5284, Dallas 35, Texas.

1—MOTOR GENERATOR mounted on 4 wheel trailer, 60 horse power Electric motor 2,000 amp 28 KW. Generator practically new. $1,000.00. Phone FL 6-2757, Box 7058, Amarillo, Texas.

LIQUIDATION

at ESSO REFINERY Balto., Md.

MOST EQUIPMENT NEW 1956

TOWERS—30" to 84" diameter, 20' to 97' high, 7 to 34 trays, up to 360 PSI

DRUMS—3' to 12' diameter, 12' to 45' long to 530 PSI, some lined—some NEW

PETRO-CHEM FURNACES—30.7; 19.3; 10.4; 9.7; 7.5 MM BTU/Hr.

NEW FURNACE TUBES—4000'—3/8" & 1/2" Wall Croloy 5—4" to 6"

PUMPS—88 to 400 GPM up to 2040' head—up to 8 Stage

HEAT EXCHANGERS—CONDENSERS

Stainless Tubes —235 to 2320 Sq. Ft.
Croloy 5 Tubes —573 to 1040 Sq. Ft.
Admiralty Tubes —216 to 1640 Sq. Ft.
Steel Tubes —238 to 2240 Sq. Ft.

COMPRESSORS & BLOWERS

7500CFM @ 42.5PSIG, 1250HP Synch.
129CFM @ 193PSIA Worth. HB 7 1/2x9

LARGE QUANTITY TRANSFORMERS & MOTORS

WRITE FOR CATALOG

HEAT & POWER CO., INC.

60 East 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa, Okla.
Boston & Haven St., Baltimore 24, Md.

FOR SALE EQUIPMENT

2500 FAILING, 58' mast, 5 x 8 pump, $25,000.00. Failing 1500 42' mast. Box 383, Chanute, Kansas.

DELONG AIRJACKS for raising drilling platforms or drydocks, 72" I.D. New surplus condition, complete. 40 available. Our price $2,500.00 each. New cost $25,000.00 each. Phone—NE 3-8027, Marine Equipment Corporation, 3060 N. W. North River Drive, Miami, Florida.

FOR SALE: Failing 1,500 heavy duty Rotary. Full hydraulic automatic breakout table, hydraulic hold down. Mounted on 1961 International. 1,300 feet of 2 3/8-in. drill pipe, new core barrel, 2 drill collars. Contact: Victor M. Loriaux, Star Route East, Nowata, Oklahoma.

LIQUIDATION

Little Rock, Arkansas

11—28,000 gal. horiz. tanks, 11' x 38', dished, ASME 75 psi.

3—Worthington #LTC-4 air comp., 3,500 CFM, 24 x 15, 500 HP, nat. gas driven.

50—Heat exchangers, T316 Stainless, up to 2,000 sq. ft.

PERRY EQUIPMENT CORPORATION
1402 NORTH SIXTH STREET
Philadelphia 22, Pa., Phone POplar 3-3505

FOR SALE EQUIPMENT

AN INVESTMENT! Productive advertising is an investment rather than an expenditure. Experienced oil men have found that The Oil and Gas Journal is their best classified advertising medium.

150,000'—5/8" USED SUCKER RODS, 7/8" Box & Pin, 25' Uniform, No. 1, @ $6.50 CFT, F.O.B. Columbus, Ohio
Subject Prior Sale
WIRE, PHONE COLLECT, WRITE

Columbus Steel Supply Company
1000 Bonham Avenue
Columbus 3, Ohio AX 4-4461

LIQUIDATING at Torrance, Cal.
CAT REFORMER NEW 1954
MUST BE OUT IN ~~90~~ 45 DAYS

TOWERS—REACTORS—HEAT EXCHANGERS
DRUMS—PRESSURESPHERES—SEPARATORS
COMPRESSORS—PUMPS—FILTERS
HOPPERS—BINS—ELUTRIATOR

Write for Inventory
Representative on Premises
Send Us Your Requirements

HEAT & POWER CO., INC.
60 East 42nd St., New York 17, N. Y.
310 Thompson Bldg., Tulsa, Okla.

ANOTHER BRILL LIQUIDATION

PAN AMERICAN PETROLEUM

SWEENY, TEXAS, GASOLINE PLANT

ABSORBERS

4—4' x 62'	2250# Absorbers
1—5' x 55'	563# Absorber
1—3' x 54'	500# Absorber
1—5'6" x 53'	200# Absorber
1—4' x 64'	60# Absorber

VESSELS

1— 5' x 22'	2000# Separator
1— 4' x 40'	1250# Separator
2— 4' x 10'	1500# Separator
2—11' x 28'	50# Drums
1—12' x 26'	200# Drums

Other small high pressure drums

ATMOSPHERIC EXCHANGERS

9—293 sq. ft.	2500# WP
12—324 sq. ft.	2500# WP
8—324 sq. ft.	1500# WP
50—720 sq. ft.	150# WP
30—460 sq. ft.	150# WP

SHELL & TUBE EXCHANGERS

12—1,690 sq. ft. steel	400# WP
6—3,570 sq. ft. steel	300# WP
4—1,900 sq. ft. Adm	300# WP
2—4,000 sq. ft. Adm	75# WP

PUMPS & COMPRESSORS

1—Carrier Refrigeration Compressor MODEL 18P301 400 hp., coolers and condensers

Approximately, 50 process pumps up to 1540 GPM and 3,700 ft. head

A large selection of gate, check and plug valves

—WIRE—PHONE—WRITE—

BRILL EQUIPMENT COMPANY

4101 SAN JACINTO ST., HOUSTON 4, TEXAS • 35–65 JABEZ STREET, NEWARK 5, N. J.

FOR SALE EQUIPMENT

80 H. P. VAPOR-CLARKSON Steam Generator, skid-mounted. Dirt cheap. Schiefer, 1704 No. Ridge Drive, Duncan, Oklahoma.

WILL SELL OR TRADE for producing properties in Kansas or Oklahoma, a 1955 Bethlehem S-45 Rotary with GM power, completely equipped to drill easily 5,000'. Operator has drilled only 46 wells with this excellent rig. Twin Drilling, Inc., 1005 Central Building, Wichita, Kansas.

1—1952 MODEL 48-L Bucyrus-Erie Drill, trailer mounted, equipped with WAKU-D Diesel engine, 70' Tripped derrick, and tool crane. Machine has been used to drill only 9,000 ft. of hole. Cleaned and repainted. The Buckeye Supply Company, P. O. Box 1231, 18 Harrison Street, Zanesville, Ohio.

TWO WATER Injection Triple Pumps, used, excellent condition: each 500 GPM at 1,200 PSIG, with 400 HP electric motor or 500 HP natural gas engine drive. Engineered Specialties Co., P. O. Box 35683, Phone FL 1-5284, Dallas 35, Texas.

SPECIAL SALE—New Bethlehem A.P.I. Pumping Units—6,400—10,000—16,000—25,000 inch lb. Torque Ratings. Prices and specifications on request—Contact Persinger Supply Company, Box 491—Williamson, W. Va.—Telephone BElmont 5-1400.

AT N. LITTLE ROCK, ARKANSAS

3—Worthington #LTC-4 compressors. 3500 CFM @ 45 PSI, 24 x 15, 2-cyl. 500 HP, 4-cycle. gas-engine drive.

Phone POplar 3-3505

PERRY EQUIPMENT CORP. 1402 N. Sixth St. Philadelphia 22, Pa.

FIRST CLASS USED DRILL PIPE

5,600 ft. 4" OD 14# Grade 'D' EUE—Used Drill Pipe with American Open-Hole FW Tool Joints—18° Taper Resleeved, Hard-banded—average 5¾" OD—FOB Oklahoma City $2.50 ft.

5,000 ft. 5" OD 19.50# Grade 'D' Used Drill Pipe w/Hughes FW 6¼" OD Square Shoulder Tool Joints, 4½" IF thd. Tuboscope #2—FOB Odessa $3.50 ft.

LUCEY PRODUCTS CORPORATION 624 S. Cheyenne—LU 4-4711 Tulsa, Oklahoma

(8) 96,000 Bbl. 120'x48'
WELDED CONE ROOF
OIL STORAGE TANKS
INSTALLED NEW in 1952
Dismantled, Matchmarked For
Reerection $75.00 N.T.
FOB Baltimore, Md.

HEAT & POWER CO., INC.
60 East 42nd St., New York 17, N.Y.
Boston & Haven Sts., Baltimore 24, Md.

EQUIPMENT WANTED

WANTED FOR CASH, 300 Sullivan used. Box M-581, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

PIPE INSPECTOR AND FIELD PURCHASING AGENT

Experience preferred. Must be willing to travel. Send complete resume to Columbus Steel Supply Co., P. O. Box 14526, Columbus, 3, Ohio.

HELP WANTED

● MECHANICAL ENGINEER

● CHEMICAL ENGINEER

Positions now available on expanding staff of independent oil refining company in Upper Midwest area.

Graduate MECHANICAL ENGINEER with two to five years experience in petroleum refinery or related engineering. Will be responsible for mechanical design and cost estimate of refinery processing equipment in Engineering department.

Graduate CHEMICAL ENGINEER with two to five years petroleum refining or petrochemical experience. Will do process studies and other technical service for operating units, plus varied staff work in Technical Service department.

These engineers will work closely with operation of a modern, integrated refinery which includes crude distillation, catalytic cracking, polymerization, coking, hydrodesulfurization, catalytic reforming, alkylation and utilities.

Furnish complete resume of experience and education, including salary requirements.

GREAT NORTHERN OIL COMPANY

ATTN: C. L. DRETZKE

P. O. Box 3596
ST. PAUL 1, MINNESOTA

PALEONTOLOGIST, 44 single, desires overseas position with oil company. 15 years experience with Tertiary and Cretaceous Foraminifera, and ammonites, in California, Colombia and Libya. Some field and wellsite work. Knows Spanish, learning Arabic. Box M-465, The Oil and Gas Journal, Tulsa, Oklahoma

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GEOLOGIST—Exploration thirteen years diversified experience Gulf Coast, Mississippi, Alabama, North Louisiana. Emphasis south Louisiana gulf coast. Will relocate. Complete resume on request. Box M-577, The Oil and Gas Journal, Tulsa, Oklahoma.

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CONCESSIONS ON untested sedimentary basin of Central America. Write, Don C. Sargent, 314 Paramount Bldg. Denver 2, Colorado.

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U. S. DEPARTMENT OF THE INTERIOR, Bureau of Indian Affairs, Crow Indian Agency, Crow Agency, Montana. Sealed bids will be received until September 28, 1961, 2:00 o'clock, P.M., Mountain Standard Time, and opened at that time in the office of the Crow Indian Agency, Crow Agency, Montana, for the leasing of 19,031.79 acres of tribal lands and 40 acres of allotted lands all located in Twp. 6 S., Rge. 32 East and Twps. 9 and 10 South, Rges. 37 and 38 East, Big Horn County, Montana, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of Crow Indian Agency, at Crow Agency, Montana.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that 26 parcels of land totaling 4,727.68 acres within the known geologic structures of a number of fields in Carbon, Converse, Natrona, Park and Sweetwater Counties, Wyoming, are offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 2:00 P.M., MST, October 25, 1961, when bids will be opened. Details of the offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Arvin H. Olswold, Chief, Minerals Section.

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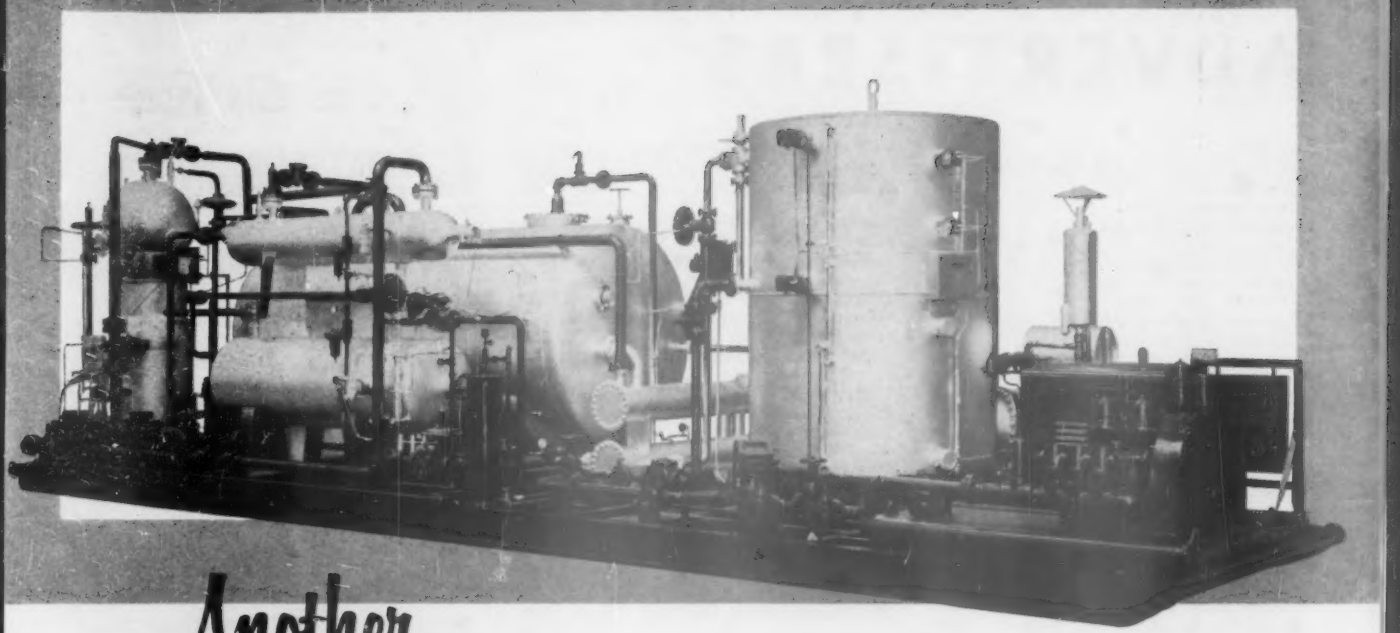

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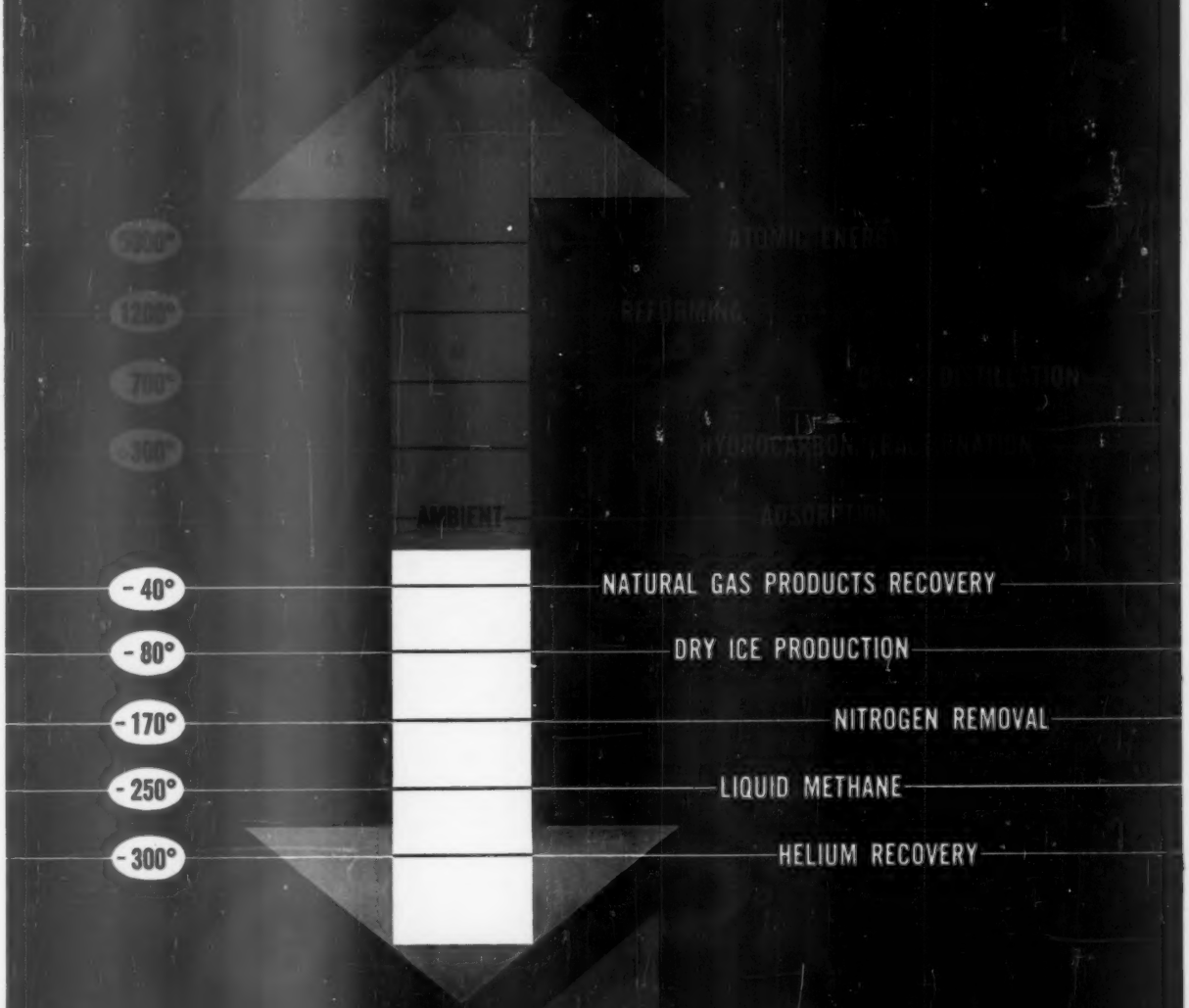

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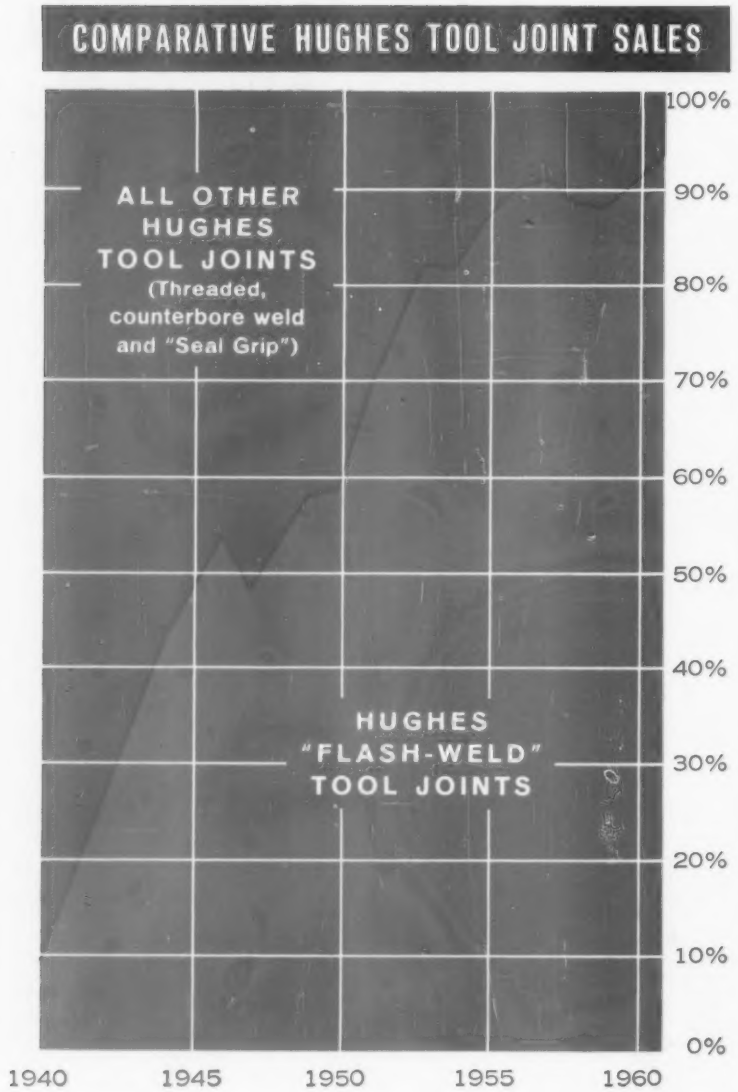

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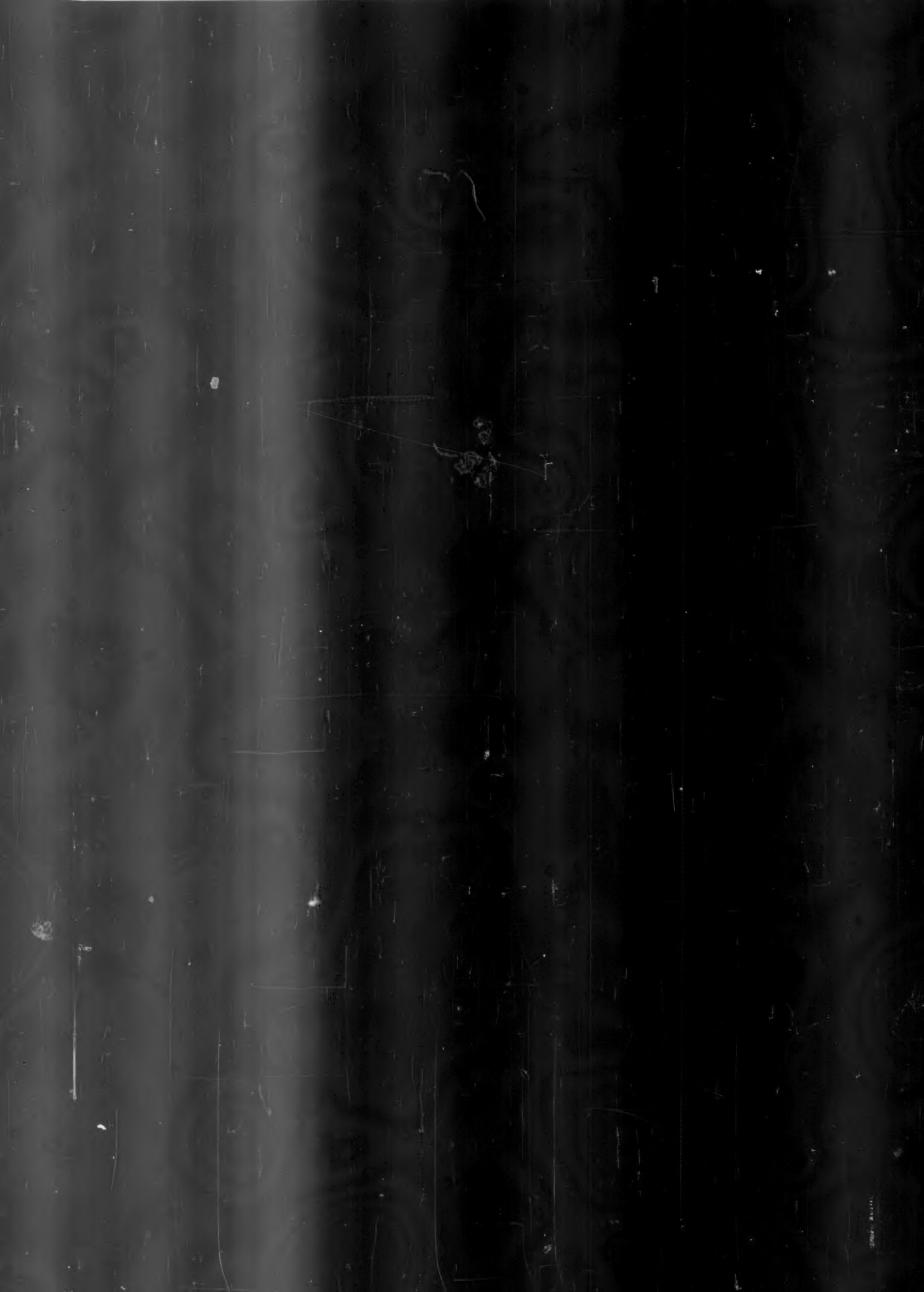

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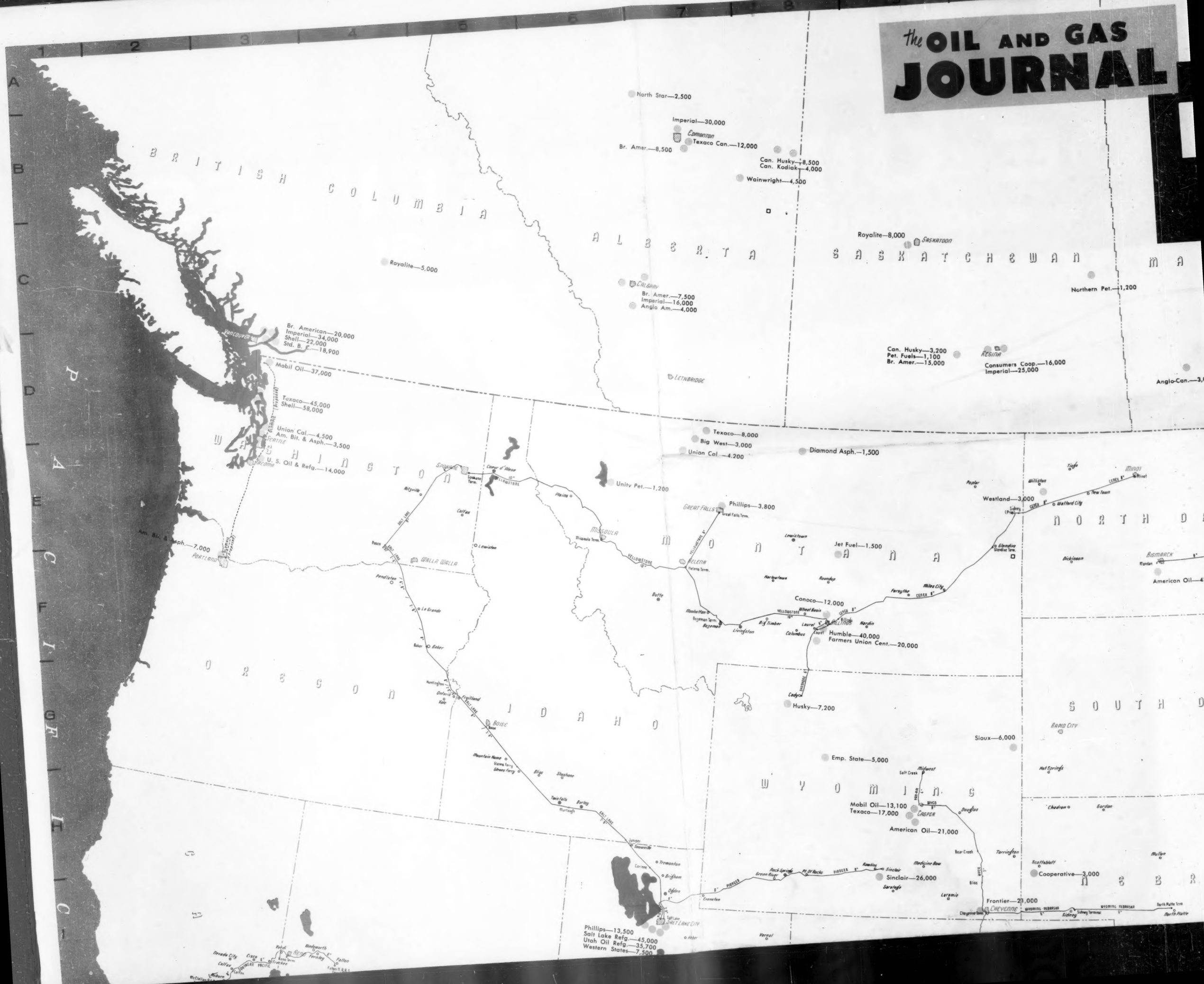

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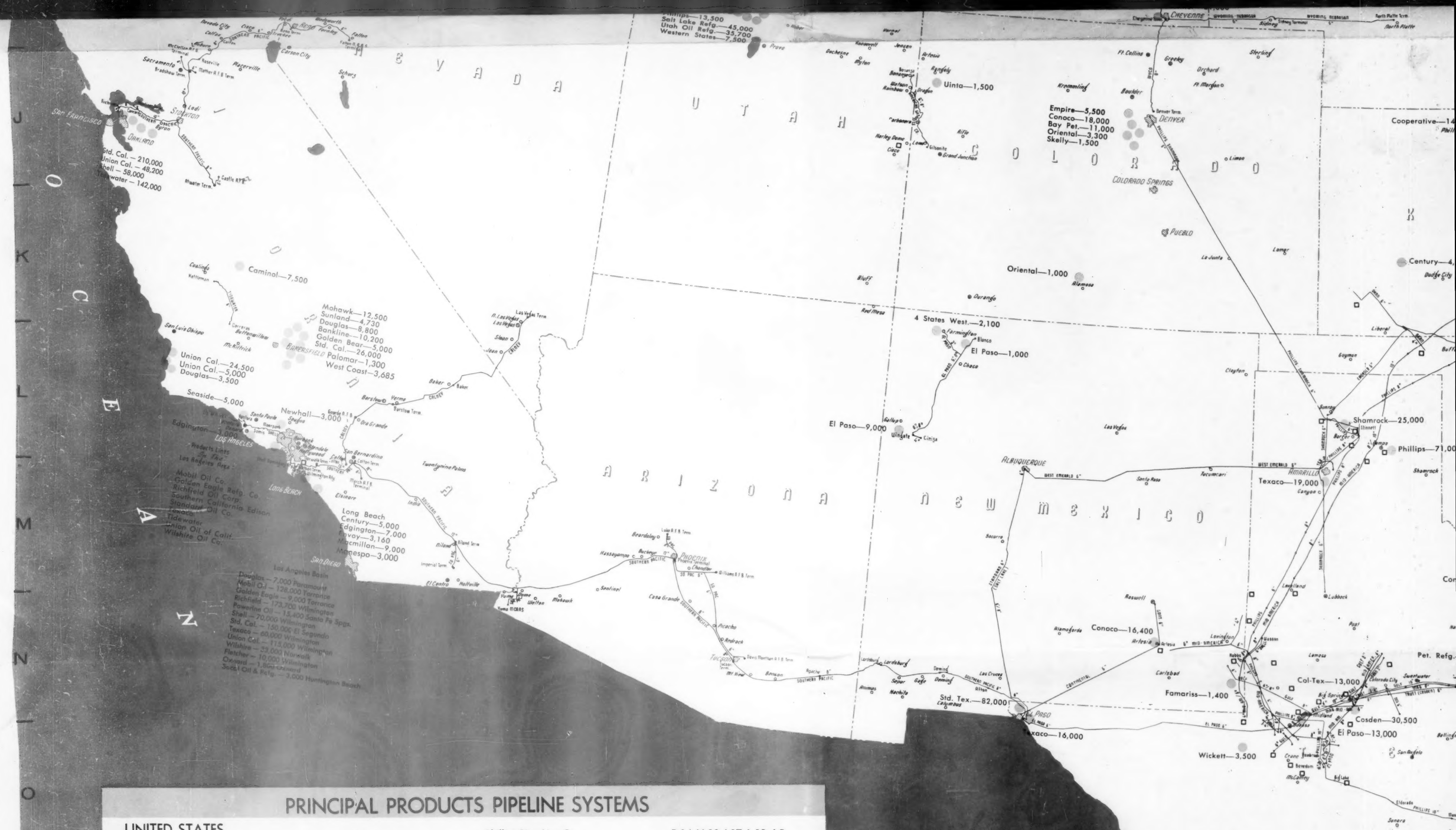

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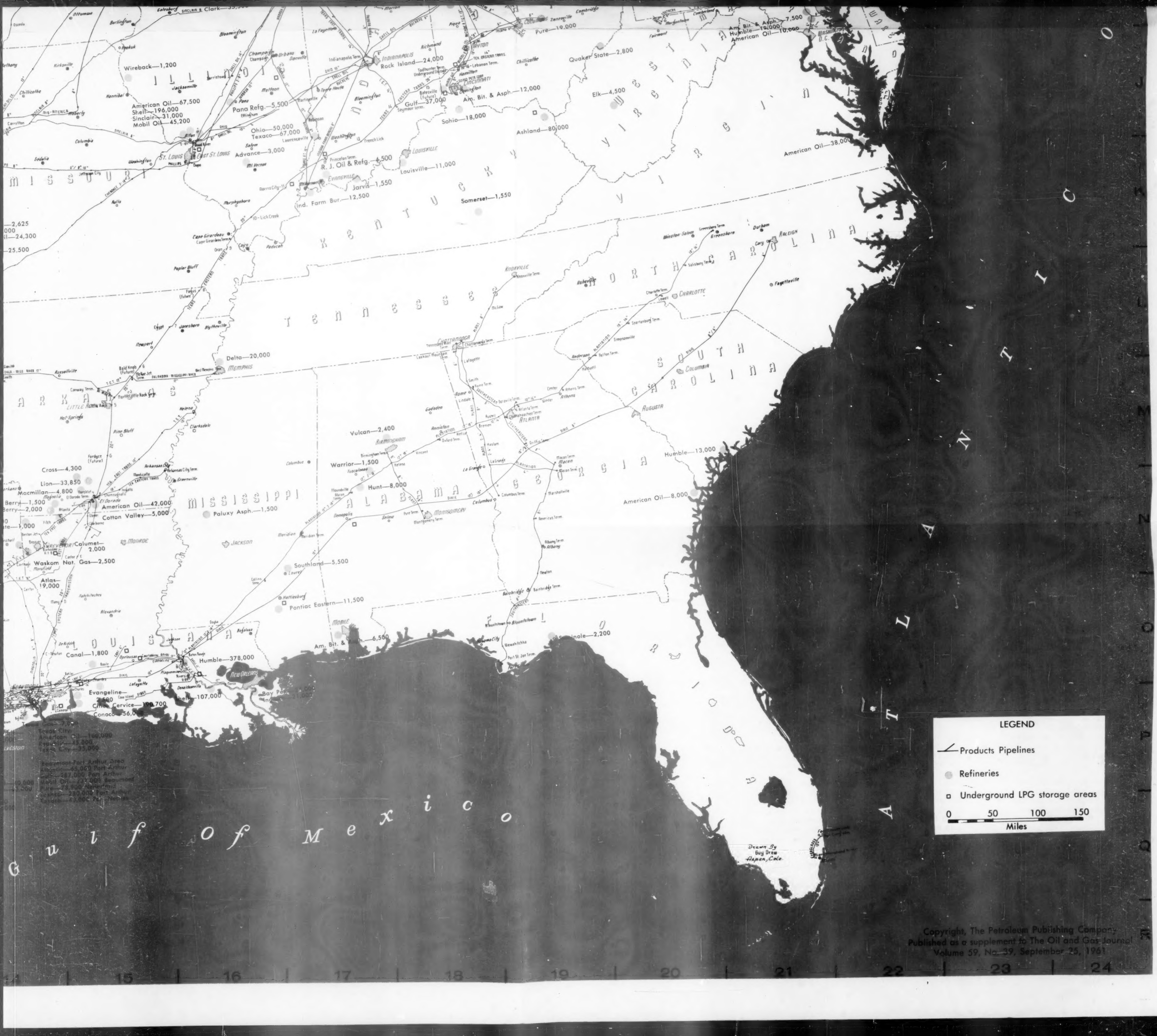
Southern Pipe Line Co.	I-20, I-22
Sun Pipe Line Co.	I-22, G-21; I-22, H-22; I-22, I-19, H-19
Texaco—Cities Service Pipe Line Co.	I-17, H-17; L-13
Texas Eastern Transmission Corp.	O-14, J-18, I-17
Texas Pipe Line Co.	P-12, N-13
Tidewater Oil Co.	K-2
Wabash Pipe Line Co.	K-16, I-17
West Emerald Pipe Line Corp.	M-8, M-10
West Shore Pipeline Co.	I-17, G-16
Wolverine Pipe Line Co.	I-17, H-18
Wyco Pipe Line Co.	H-9, J-19
Wyoming Nebraska Pipe Line Co.	I-9, I-11
Yellowstone Pipe Line Co.	E-5, G-8

CANADA

Imperial Oil Ltd.	H-19, G-20
Sun-Canadian Pipe Line Co., Ltd.	H-19, G-20
Trans-Northern Pipe Line Co.	G-20, F-22

Cooperative—14,000
Phillipsburg
American Oil—78,500
Wireback—1,200
American Oil—67,500
Shell—196,000
Sinclair—31,000
Mobil Oil—45,200
Pana Refg.—5,500
Ohio—50,000
Texaco—67,000
Advance—3,000
Phillips—70,000
National Co-op—33,000
Vickers—17,200
Skelly—48,000
Mid-America—2,625
Chanute—1,000
American Oil—24,300
Cooperative—25,500
Century—4,200
Derby—20,500
Mobil Oil—42,000
Amer. Petrofina—20,000
And.-Prich.—26,000
Cities Service—37,500
Conoco—77,000
Champlin — 33,000
Kerr McGee — 22,000
Midland Coop — 13,000
Texaco—40,000
DX Sunray—75,000
Phillips—19,000
Shamrock—25,000
Phillips—71,000
Allied—3,400
And.-Prich.—12,500
DX Sunray—45,000
Bell—8,000
Ben Franklin—12,000
Kerr McGee — 25,000
Conoco—12,000
Am. Petrofina—10,000
Bryson—2,000
Pet. Refg.—2,630
Premier—2,500
Cosden—30,500
El Paso—13,000
Tex—13,000
Tydal—2,000
Premier—8,000
Great West—2,300
Premier—6,000
Cross—4,300
Lion—33,850
Macmillan—4,800
Berry—1,500
Berry—2,000
American Oil—42,000
Cotton Valley—5,000
Am. Petrofina—20,000
Bayou State—1,000
Skelly—5,000
Calumet—2,000
Waskom Nat. Gas—2,500
LaGloria—25,000
Anderson—2,630
Atlas—19,000
Canal—1,800
Howell—3,000
Monarch—4,000
Danaho—12,000
Texstar—2,800
Three Rivers—1,500
Phillips—95,000
Cactus—5,000
Paluxy Asph.—1,500
Humble—378,000
Evangeline—2,500
Shell—107,000
Gas—7,000
Texas City
American Oil—160,000
Republic—45,000
Texas City—35,000
Houston
Crown Central—40,000
Eastern States—65,000
Eday—2,000
Shell—133,000
Sinclair—150,000
Beaumont-Port Arthur Area
Atlantic—65,000 Port Arthur
Gulf—287,000 Port Arthur
Mobil Oil—137,000 Beaumont
Pure—78,900 Nederland
Texaco—260,000 Port Arthur
Texaco—40,000 Port Neches
Corpus Christi
Delhi-Taylor—42,000
Howell—5,000
Pontiac—45,000
Sinclair—31,000
Southwestern—37,000
Sunlite—65,000
Delhi-Taylor—13,800
Premier—5,300
Ind. Farm Bur.—12,500
Princeton Term.
R. J. Oil & Refg.—4,500
Jarvis—1,550
Louisville—11,000
Somerset—1,550
Pure—19,000
Rock Island—24,000
Gulf—37,000
Sohio—18,000
Am. Bit. & Asph.—12,000
Ashland—80,000
Quaker State—2,800
Elk—4,500
Humble—13,000
American Oil—8,000
Vulcan—2,400
Warrior—1,500
Hunt—8,000
Southland—5,500
Pontiac Eastern—11,500
Am. Bit. & Asph.—6,500
Delta—20,000
Gulf of Mexico
Drawn By Big Drew Atlanta, Ga.



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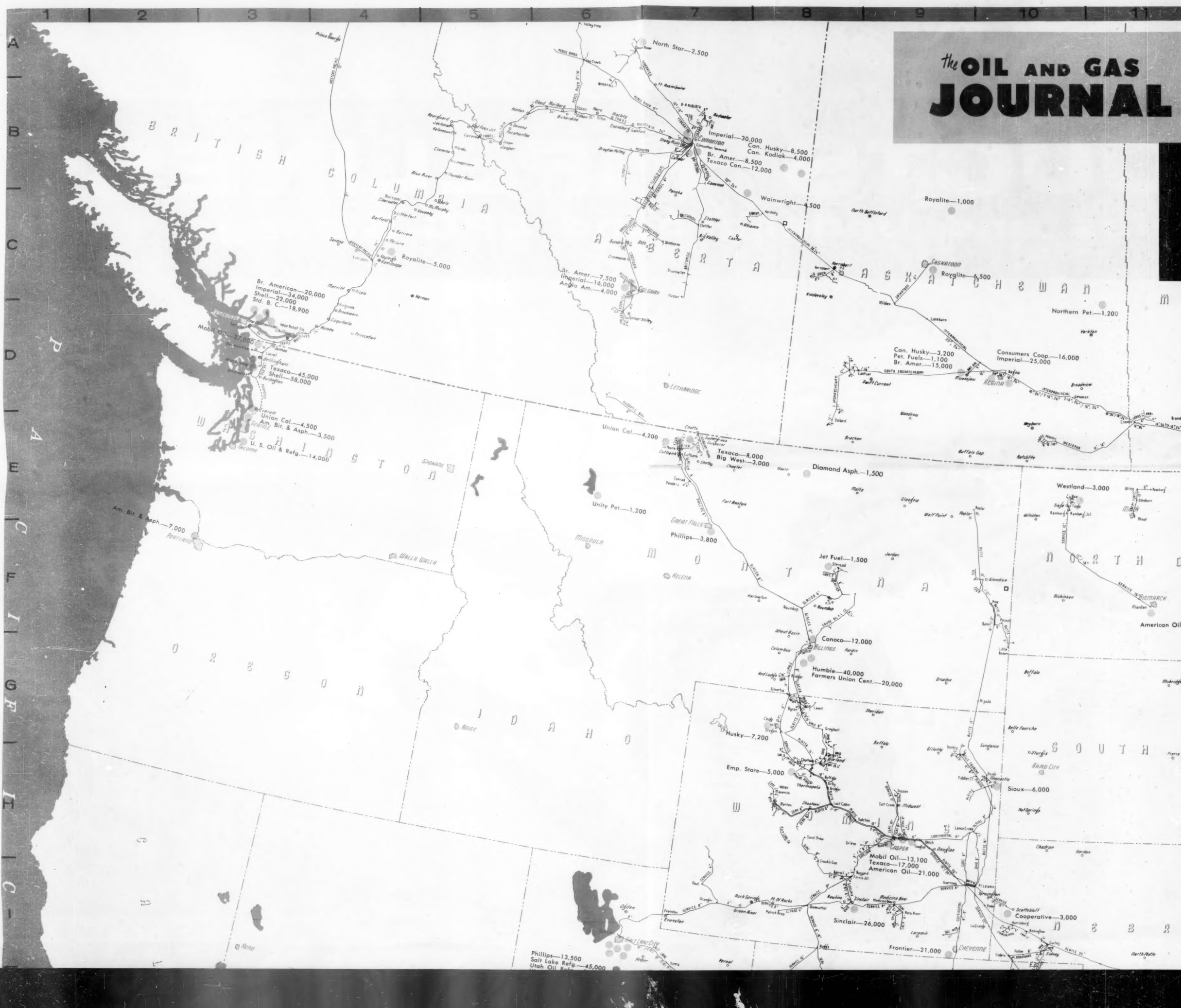
Published as a supplement to The Oil and Gas Journal
Volume 59, No. 39, September 25, 1961

the OIL AND GAS JOURNAL



GAS
NAL

CRUDE-OIL PIPELIN

Refineries and Underground LPG Stor

MANITOBA

hern Pet.—1,200

Anglo-Can.—3,000

Imperial—19,150
North Star—13,500

stland—3,000

American Oil—43,000

NORTH DAKOTA

SOUTH DAKOTA

MINNESOTA

International—15,000

Lake Superior Refg.—15,000

Northwestern—2,500
Northwestern—17,000
Great Northern—35,000

WISCONSIN

Empire—5,500

IOWA

NEBRASKA

Pure—47,500
Texaco—67,000

Mobil Oil—37,800
Cities Service—58,000
American Oil—235,000
Sinclair—120,000

Gladieux—2,000

Std. Ohio—50,000

Ashland—35,000

Osceola—2,630

West Branch—1,260

Leonard—7,700

Bay—17,500

Leonard—21,500

Crystal—7,050
Marvel—1,500

Lakeside—4,420

Imperial—100,000
Sun—15,000
Can. Oil—30,000

Std. Ohio—55,000

Cities Service—20,000
Br. Amer.—61,500
Regent—21,050

Ashland—30,000

Mobil Oil—31,050

Kendall—5,200
Quaker State—4,500

United—15,600

Pennzoil—10,400
Sonneborn—2,350
Wolf's Head—2,000
Quaker State—3,000
Penn. Refg.—1,580

Ashland—6,000

Can. Petrofina—30,000
Texaco Can.—59,000
Imperial—79,900
Br. Amer.—50,000
Shell—62,000

Lake Superior

Lake Michigan

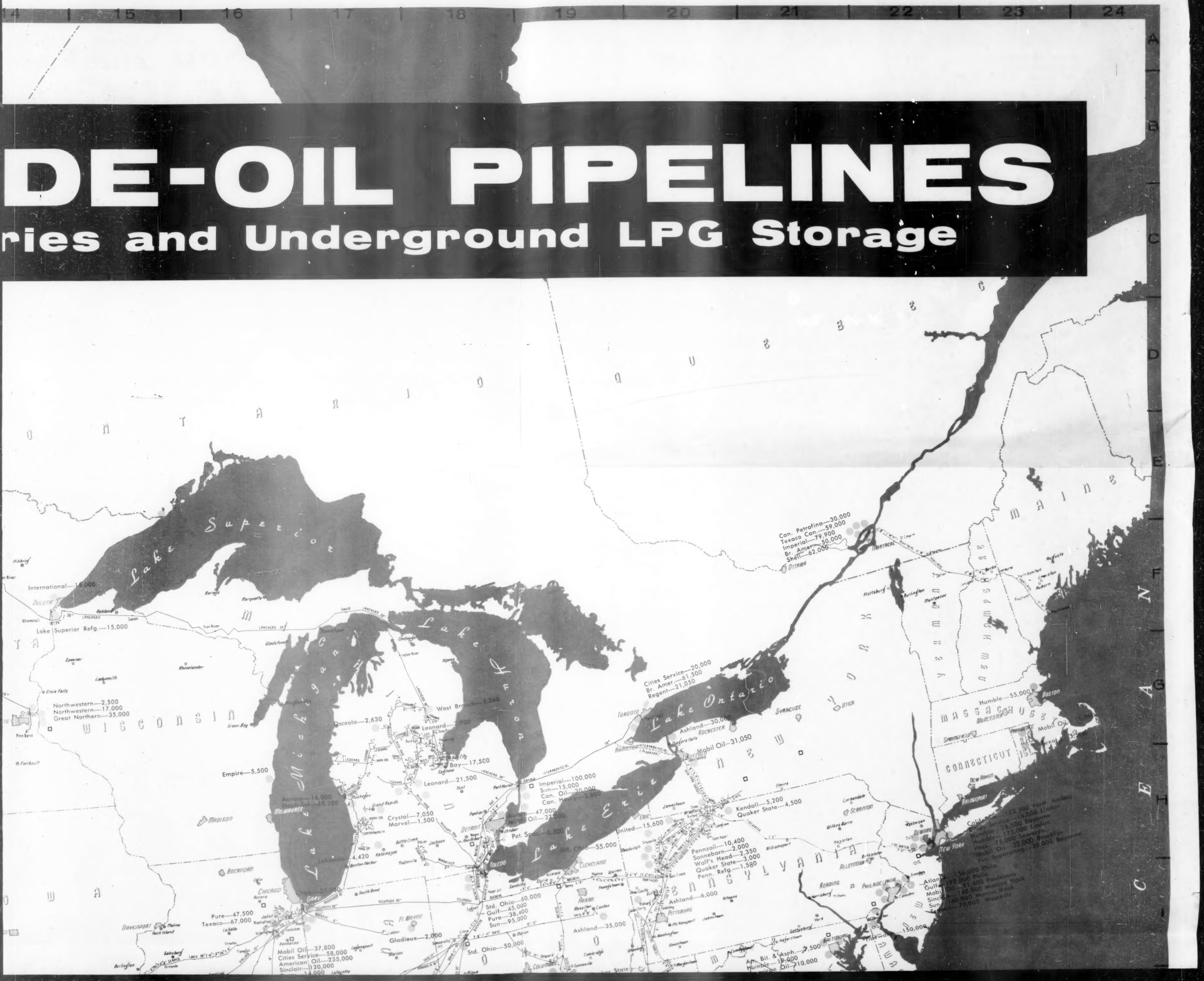
Lake Huron

Lake Erie

Lake Ontario

DE-OIL PIPELINES

ries and Underground LPG Storage



UNITED STATES

Arapahoe Pipe Line Co.	I-10, K-13
Arkansas Pipeline Corp.	N-15, N-14
Ashland Pipe Line Co.	K-18, J-19
Atlantic Pipe Line Co.	O-10, P-14, N-14
Basin Pipe Line Co.	O-10, L-13
Buckeye Pipe Line Co.	I-17, I-19, J-19
Butte Pipe Line Co.	E-9, I-9
Champlin Oil & Refining Co.	L-12, M-12
Cherokee Pipe Line Co.	M-12, M-13
Cities Service Pipe Line Co.	P-14, P-15
Continental Pipe Line Co.	J-9, H-9; K-12, N-12; R-12, R-13; O-14, O-15
Cooperative Refinery Ass'n.	J-12, L-13
Eureka Pipe Line Co.	J-19, I-20
Four Corners Pipe Line Co.	L-8, M-3
Glacier Pipe Line System	E-7, G-8
Gulf Pipe Line Co.	O-10, N-12; L-13, I-18 J-18 L-13, P-14
Hess Pipeline Co.	O-17, N-17
Humble Pipe Line Co.	O-10, P-14; O-10, Q-13; N-13, O-13 N-14, P-16, N-16; M-11, P-14; G-8
Jayhawk Pipe Line Corp.	L-10, K-12
Kaw Pipe Line Co.	J-11, K-12
Kerr-McGee Oil Industries, Inc.	M-12, M-13; L-13
Lakehead Pipe Line Co., Inc.	E-12, H-19
Leonard Crude Oil Co.	H-17,
Magnolia Pipe Line Co.	M-13, N-10, Q-12, P-14, N-13, I-18
Mid-Continent Pipe Line Co.	M-12, L-13
Mid-Valley Pipeline Co.	N-14, I-18
Michigan-Ohio Pipeline Corp.	G-17, I-18
Minnesota Pipe Line Co.	F-13, G-14
Muskegan Pipe Line Co.	H-17, I-17
National Transit Co.	I-20, H-20
New York Transit Co.	H-20
Northern Pipe Line Co.	I-19, H-20
Ohio Oil Co.	G-8, H-8; K-16, I-18
Ozark Pipe Line System	L-13, K-16
Pasotex Pipe Line Co.	O-8, N-11
Phillips Pipe Line Co.	E-7; O-10, L-11 L-13, K-14
Platte Pipe Line Co.	H-8, K-16
Portland Pipe Line Corp.	F-23, F-22
Pure Transportation Co.	N-13, P-14
Rancho Pipe Line System	O-10, P-14
Richfield Oil Corp.	L-3, M-3
Salt Lake Pipe Line Co.	J-8, I-6
Service Pipe Line Co.	G-8, J-6, J-7; O-9, O-11, L-13; K-14, P-14, N-14; E-10, F-11.
Shell Pipe Line Corp.	J-2, M-3; O-10, K-16; O-16, P-17,
Sinclair Pipe Line Co.	P-14, L-13, I-17; H-8, H-9
Skelly Oil Co.	K-12, K-13
Sohio Pipe Line Co.	I-18, K-16
Sun Pipe Line Co.	Q-12; N-14, P-14
Suntide Pipe Line Co.	P-12, P-13
Standard Oil Co. of California	J-2, L-3
Tecumseh Pipe Line Co.	I-17, I-18
Texaco-Cities Service Pipe Line Co.	L-13, K-13, I-17; J-16, K-16
Texas-New Mexico Pipe Line Co.	K-7, N-11
Texas Pipe Line Co.	M-12, P-13, P-16; M-13; J-15, J-16; E-7
Tidewater Oil Co.	L-3, J-2
Tide-Water Pipe Co., Ltd.	H-20, H-22
Trans Mountain Oil Line Corp.	D-3
Union Oil Co. of California	J-2, L-3
West Texas Gulf Pipe Line Co.	N-12, P-14

CANADA

Britamoil Pipe Line Co., Ltd.	B-7, C-7
Cremona Pipe Line Division	C-6
Federated Pipe Lines Ltd.	A-6, B-7
Interprovincial Pipe Line Co.	B-7, E-12; H-19, G-20
Imperial Pipe Line Co. Ltd.	B-7
Montreal Pipe Line Co. Ltd.	F-22, E-22
Peace River Oil Pipe Line Co. Ltd.	A-6, B-7
Pembina Pipe Line Ltd.	B-7, B-6
Rangeland Pipe Line Division	C-6
South Saskatchewan Pipe Line	D-10, E-8
Trans Mountain Oil Pipe Line Co.	B-7, D-3
Western Pacific Products & Crude Oil Pipelines	A-4, C-4
Westspur Pipe Line Co.	E-11, E-10
Gibson Crude Oil Purchasing Co.	C-8, C-7
Saskatoon Pipe Line Co. Ltd.	D-9, C-9
Winnipeg Pipe Line Co. Ltd.	E-12
Trans-Prairie Pipelines, Ltd.	E-10
Valley Pipe Line Co. Ltd.	D-6, C-6

Cooperative—14,000
Century—4,200
Derby—20,500
Mobil Oil—42,000
Vickers—17,200
Skelly—48,000
National Co-op.—33,000
Phillips—70,000
American Oil—78,500
Kansas City
Topeka
Wireback—1,200
Pana Refg.—5,500
American Oil—67,500
Shell—196,000
Sinclair—31,000
Mobil Oil—45,200
Mobil Oil—37,000
Cities Service—58,000
American Oil—235,000
Sinclair—120,000
Berry—14,000
Allby—10,000
Laketon—4,500
Rock Island—24,000
Indianapolis
Std. Ohio
Pure—19,000
Dayton
Quaker State—2,800
Am. Bit. & Asph.—12,000
Humble—P-000
American Oil—210,0
Gulf—37,000
Cincinnati
Sohio—18,000
Ashland—80,000
Fl—4,500
Ohio—50,000
Texaco—67,000
R. J. Oil & Refg.—4,500
Louisville
Louisville—11,000
Jarvis—1,550
Advance—3,000
Ind. Farm Bur.—12,500
Somerset—1,550
Amer. Petrofina—20,000
Mid-America—2,625
Chanute—1,000
American Oil—24,300
Cooperative—25,500
And.-Prich.—26,000
Conoco—77,000
Cities Service—37,500
Champlin—33,000
Shamrock—25,000
Phillips—71,000
Texaco—19,000
Kerr McGee—22,000
Midland Coop—13,000
Texaco—40,000
DX Sunray—75,000
Phillips—19,000
Allied—3,400
And.-Prich.—12,500
DX Sunray—45,000
Bell—8,000
Kerr McGee—25,000
Ben Franklin—12,000
Conoco—12,000
Am. Petrofina—10,000
Tydal—2,000
Bryson—2,000
Pet. Refg. 2,630
Premier—8,000
Great West—2,300
Col-Tex—13,000
Premier—2,500
Cosden—30,500
El Paso—13,000
LaGloria—25,000
Anderson—2,630
Premier—6,000
Berry—1,500
Berry—2,000
Am. Petrofina—20,000
Bayou State—1,000
Skelly—5,000
Cross—4,300
Lion—33,850
Macmillan—4,800
American Oil—42,000
Cotton Valley—5,000
Calumet—2,000
Atlas—19,000
Waskom Nat. Gas—2,500
Paluxy Asph.—1,500
Vulcan—2,400
Warrior—1,500
Hunt—8,000
Southland—5,500
Pontiac Eastern—11,500
Seminole—2,200
Humble—13,000
American Oil—8,000
Houston:
Crown Central—40,000
Eastern States—65,000
Eddy—2,000
Shell—132,000
Sinclair—150,000
Canal—1,800
Humble—378,000
Humble—309,000
(Beaumont-Port Arthur Area)
Atlantic—65,000 Port Arthur
Gulf—287,000 Port Arthur
Mobil Oil—237,000 Beaumont
Pure—78,900 Nederland
Texaco—260,000 Port Arthur
Texaco—40,000 Port Neches
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American Oil—160,000
Republic—45,000
Texas City—35,000
Howell—3,000
Monarch—4,000
Danaho—12,000
Three Rivers—1,500
Texstar—2,800
Corpus Christi:
Delhi-Taylor—42,000
Howell—5,000
Pontiac—45,000
Sinclair—31,000
Southwestern—37,000
Suntide—65,000
Cactus—800
Delhi-Taylor—15,800
Premier—5,500
Gulf of Mexico
Drawn By
Guy Dre
Aspen, Col
11
12
13
14
15
16
17
18
19
20
21

Mobil Oil—37,000
Cities Service—58,000
American Oil—235,000
Sinclair—120,000
Berry—14,000
Allby—10,000
Laketon—4,500

Std. Ohio—

Wireback—1,200

Rock Island—24,000

Pana Refg.—5,500
American Oil—67,500
Shell—196,000
Sinclair—31,000
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Gulf—37,000

Ohio—50,000
Texaco—67,000

Pure—19,000

Quaker State—2,800

Am. Bit. & Asph.—2,500
Humble—19,000
American Oil—10,000

Am. Bit. & Asph.—12,000

Sohio—18,000

Ashland—80,000

Elk—4,500

American Oil—38,0

R. J. Oil & Refg.—4,500

Louisville—11,000

Advance—3,000

Jarvis—1,550

Ind. Farm Bur.—12,500

Somerset—1,550

Delta—20,000

Vulcan—2,400

Warrior—1,500

Hunt—8,000

Cross—4,300
Lion—33,850
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American Oil—42,000

Cotton Valley—5,000

Paluxy Asph.—1,500

Calumet—2,000

Atlas—19,000
Waskom Nat. Gas—2,500

Southland—5,500

Pontiac Eastern—11,500

Seminole—2,200

Canal—1,800

Humble—378,000

Evangeline—

Humble—309,000

Beaumont-Port Arthur area:
Atlantic—65,000 Port Arthur
Gulf—287,000 Port Arthur
Mobil Oil—237,000 Beaumont
Pure—78,900 Nederland
Texaco—250,000 Port Arthur
Texaco—40,900 Port Neches

American Oil—8,000

Humble—13,000

Drawn By
Guy Drew
Aspen, Colo

LEGEND

- Crude-Oil Pipelines
- Refineries
- Underground LPG storage areas

0 50 100 150
Miles

Copyright, The Petroleum Publishing Company
Published as a supplement to The Oil and Gas Journal
Volume 59, No. 39, September 25, 1961